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Molded Products and Their Manufacture

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THERE are two fundamental methods of forming plastic compounds into finished industrial and commercial products. These two processes are known, respectively, as hot molding and cold molding.

The former process consists of placing a prepared compound, either powdered, in a pasty mass, or in a solid condition, into a carefully machined and hardened steel mold, and applying pressure and steam heat to the mold in a hydraulic press. The parts come out completely formed, accurate in dimensions, and with a high finish. After the slight flashings are removed from the line where the mold parts came together, which is a simple sanding or buffing operation, the products are ready for use. Tapping is usually the only machining operation required, all finishes, holes and inserts being introduced in the molding process.

The cold process likewise employs steel molds in hydraulic presses, but no heat is applied. The materials usually consist of an asphalt binder with a mineral filler, a lime or silicate binder with an asbestos filler, or other compound introduced in powdered or flake form. Molding in this case is followed by baking in an oven for a period of from perhaps twenty-four hours to a week.

Hot molding, originally more expensive, is rapidly lowering in cost by reason of the reduction of the setting time and the use of multiple molds turning out upwards of a hundred pieces at a time in the press, and is displacing cold molding. In these articles we shall devote our attention mainly to the hot-molded plastics, or thermo-plastics, as they are sometimes called. There are numerous materials coming within this classification, all differing fundamentally from each other in chemical and physical composition and properties.

Metal parts in many cases are being replaced by products molded from plastic materials, especially those compounded from synthetic resins. The molded parts are simple in design, accurate in dimensions, usually require no machining, have many useful properties, are rapidly and easily manufactured, and are low in cost under mass production

Essentially, a thermo-plastic is any material which can be formed to a definite and fixed shape, at a single operation, in a mold, under application of heat and pressure. This definition excludes all of those materials which become sufficiently molten, or liquid, to pour into a mold, without pressure, and also all materials molded by pressure alone. In this latter class are the cold-molded plastic materials, which, while processed by methods and equipment closely allied to those used in the thermo-plastic molding industry, are not subjected to heat until they are put through the subsequent baking operation.

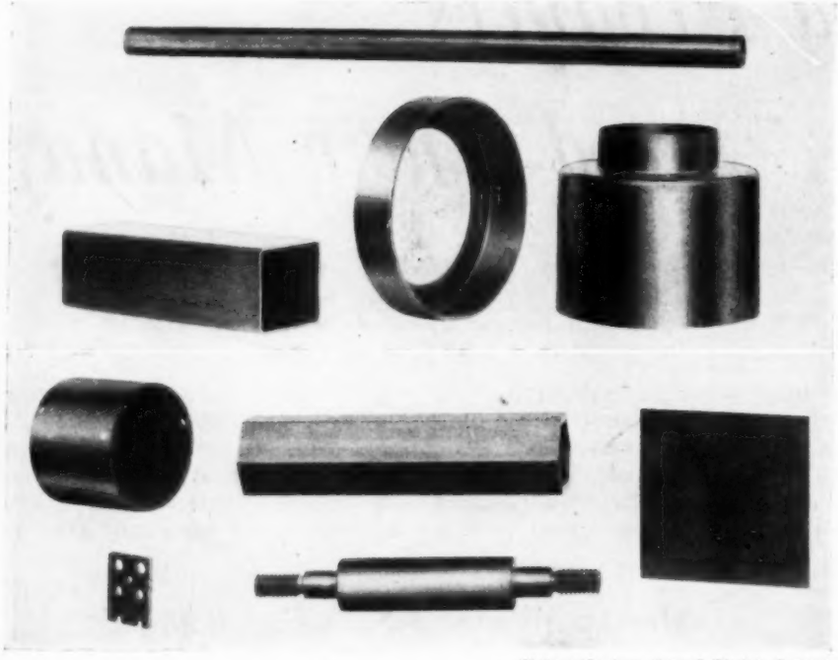
From the standpoint of permanency of the finished article, we have two general types of molded materials. In one case, the molded article becomes plastic upon reheating, and can be remolded to a new form. Materials of this kind change only physically in the molding operation, and are known as the fusible type. In the second case, a chemical change takes place during molding, producing an infusible product. While these materials may be affected by reheating, at least they cannot be reworked. These are known as condensation products, or

The first of a series of articles. The second article, to appear in an early issue, will deal with molds.

synthetic resins, and acquire a permanent set, with complete change of chemical structure under the heat and pressure.

While popular interest in plastics at the present time is centered chiefly in the synthetic molding materials which have put in their appearance in the last twenty years, the importance of the older plastics must not be overlooked, and hence they also are briefly described in the present article.

Rubber was the first plastic to be employed, and in point of usefulness is still the most important plastic we have. Its utility is directly due to the discovery of vulcanizing by Goodyear, in 1839. Previous to that it was largely a curiosity, ill-suited to practical needs. Rubber is a gum-resin exudation of the rubber tree, which grows in many species in all tropical countries. Crude rubber is made by evaporating the liquid, or latex, and drying over a fire. Rubber, and the related substances gutta percha and balata, have the property of being capable of vulcanization by the addition of sulphur. The vulcanized rubber besomes harder and more elastic. The amount of sulphur added depends upon the hardness desired in the finished product, and the baking or curing time to be employed. If the product to be made need not be all-rubber, the compounding may also include the incorporation of an inert material, either fibrous or powdered, to reduce cost, and to impart desired physical properties.



Photographs from General Electric Company

Fig. 1 — These products of Textolite, a synthetic resin compound, are typical molded plastic parts

When the compounding of the rubber is completed, the material is ready for molding. It is put, in slight excess, into pre-heated molds of steel or cast-iron, which are then closed in a press, while heat is further applied by steam plates. In the case of soft-rubber goods, the curing time may be as much as four hours, depending upon size of article, at the end of which time the article is stripped from the hot mold, the excess material, used to insure complete filling of the mold, having been squeezed out during the first part of the molding operation. In the case of hard-rubber molding, after the batch has been correctly compounded, it is given a preliminary molding corresponding to the process described above. After this operation the pieces are inserted in molds made of soft material, such as type metal, and again baked under pressure for a period of perhaps 36 to 48 hours. Upon completion of the lot or order, these soft molds are melted and re-cast into other molds, thereby greatly reducing cost below that required where hard-metal molds are used.

Since no other natural material has properties like rubber, its competition comes only from synthetic products. Rubber was made synthetically during the War, but it has not yet been produced at costs making it commercially practical. In the molding of rigid articles, rubber has been largely displaced by plastics of more recent development, but in the soft-product field there is as yet no satisfactory substitute available. It is elastic, airtight, waterproof, chemically quite resistant, and an excellent insulator. Another advantage in its use is that, having been available to the public for so long in the form of common products, it requires no expensive educational advertising campaign, like a new material.

Celluloid and pyroxylin plastics date back to the patents of Hyatt in 1870, and their versatility was early appreciated and made use of. In the making of celluloid, or pyroxylin plastic, any cellulose may be employed, such as that from wood, cotton, grass, but the lignen and resins of the wood must be dissolved out. At the present time cotton linters are most extensively used as raw material, having displaced rag-paper. Cotton is valuable for this purpose as it is almost pure cellulose. This cellulose is cleaned with hot potash solution and is treated with nitric acid, after which it is washed in water, and put through a centrifugal dryer. The remaining moisture is removed by a bath of alcohol, which is, in turn, removed in a dehydrating press. The material, cellulose nitrate, commonly called nitro-cellulose, has the the appearance of the original cotton but its chemical constitution has been entirely changed. For molding products the nitration is not carried as far as for the manufacture of explosives, and it is therefore not as inflammable nor explosive.

Pyroxylin is nitro-cellulose dissolved in a chemical solvent, such as an alcohol or ether. Celluloid is the old name for the product after the addition of camphor for hardening and to make it less inflammable. The pyroxylin plastic, besides camphor, may also contain a filler material. The material is rolled for several hours, coloring pigments or dyes being added during the operation. After this, it may be put through extruding presses for the forming of rods or tubes, or, if sheets are wanted, the rolled material is baked under pressure in large blocks, which are later cut into sheet stock on a planer. In either case, the preparation of the raw material is complete with the seasoning or drying of the sheeted, or extruded stock, and the usual polishing of the sheets.

In molding this plastic, the material is prepared either from sheet stock, or rods, into blanks which are roughly

the same general shape as the mold to be filled, and have slightly more volume. The blanks are preheated and loaded into a hot mold, which is then placed in a press, and further heated until the stock becomes sufficiently plastic to allow the parts of the mold to come together, the excess stock flowing out. After chilling under pressure the work is ejected. Molding pressures vary from 2,000 to 3,000 lb. per sq. in., depending upon the plasticity of the stock. The material softens at about 180 deg. F. and may be molded with decreasing pressures up to 250 deg. F., beyond which it is not advisable to go. Advantage is taken of this low initial temperature to use hot water as a convenient pre-heating medium in some special classes of molding, especially in the operation known as "drawing," which consists of forming from thin sheet stock. In the production of hollow articles from sheet stock, rubber and pyroxylin plastics have the field to themselves, both being readily adaptable to this special class of molding known as "blowing."

Pyroxylin plastic has many advantages. Perhaps the most important to the molder is the unlimited number of color reproductions and combinations possible for the manufacture of an ever-changing line of attractive goods. Ease, and especially cleanliness, of manipulation are in its favor, while its flexibility is a desirable characteristic for some uses. It is, of course, inflammable and this characteristic precludes its use for some specific purposes. It lacks the hardness and resistance of the condensation plastics. Trade names include Amerith, Fiberloid, Pyralin, and Xylonite.

Other Plastics

By treating cellulose with acetic acid, a non-inflammable compound, cellulose acetate, very similar to celluloid, is formed. It is lighter in color than the pyroxylin plastic and does not discolor so easily.

This product, like celluloid, is first formed into rods, sheets, tubes and blocks, from which pieces are cut, of sizes to fit into the respective molds. Hollow ware is formed by placing sheets in the molds and blowing steam between them to soften the material and shape it to the mold. Cold water then introduced into the mold, or around it, hardens the material. Solid objects are blanked out of sheets or blocks and then molded. The compound has also been recently introduced in powdered form and successfully used.

Shellac as a plastic brings us to the consideration of a type of material entirely different from those previously mentioned. It was the first resinous plastic used.

In the case of a resinous plastic, the resin is actually used only as a binder. With the resinous material, or binder, a filler of some inert material is incorporated, this compounding being effected for two reasons. First, the cost of the resin itself makes the use of a diluent an economy, and secondly, the resin alone generally lacks some desirable physical property for each different purpose, which may be imparted by proper choice of filler. In use, the resin becomes sufficiently plastic under heat and pressure to flow around the particles of filler, closing the voids, and producing a solid instead of a porous product. The resin also coats the individual particles of filler along the surface, completely inclosing them and giving a smooth, glossy finish.

In the preparation of shellac compounds, the shellac is first ground and then mixed dry with the filler. After dry mixing, the batch is worked into a plastic condition on heated rolls, until thoroughly blended. Then it is run through blanking rolls which mark off the material so that after cooling it will readily break into slabs of a convenient size. A compound satisfactory for general molding is made in the proportion of three parts of filler to one of shellac, the filler being composed of inert minerals, fibers, or other materials.

In molding, the shellac compound is preheated to plasticity on a steam table. The operator cuts off the required amount of material, which is then loaded into a warm mold and the mold closed in a press, where further heat is applied. The material is molded at about 240 deg. F. under a pressure of 1,000 to 1,200 lb. per sq. in. The work requires chilling, to insure holding its shape upon ejection.

Shellac compounds are characterized by ease of manipulation. The human element is not quite so important as with some of the other resinous compounds, since extreme precision in temperature and time are not absolutely essential to good work. Shellac-molded products have very good electrical insulating properties, and fair mechanical strength. They may be produced with a very smooth surface finish, and in various colors. Shellac molding forms a large part of the plastic molding industry, and although later plastics have encroached on the field to some extent, yet, in the manufacture of items such as phonograph records, no substitute has been able to displace it.

Treating skim milk with acid precipitates a product known as casein, a yellowish white substance. The action of formaldehyde on rennet casein produces casein resin, a plastic used extensively as a molding material. Calcium chloride, or other hygroscopic salt is introduced to prevent the substance from becoming rubbery.

Casein plastics are easily molded under heat and pressure. They are non-inflammable, good insulators and can be dyed to any color. They machine more easily than phenol resin plastics, but are not so hard and durable. They are known under various names, such as Alladinite, Inda, Erinoid, Karolith. Their chief use is in molded ornaments rather than for mechanical parts.

Phenol Formaldehyde Resins

Experiment has brought to light about fifteen hundred synthetic resins, some of which have proved very desirable for molding. The first of these to be developed, and the one most used at the present time, is the resin produced by the reaction of phenol (carbolic acid) and formaldehyde, known as phenol-formaldehyde resin, which may be easily recognized under its various trade names of Bakelite, Durez, Celoron, Colasta.

These resins are produced by the reaction of phenol and formaldehyde in a closed digestor, under the application of heat and aided by an acid catalyst or ammonia. During the first part of the reaction, a clear amber fluid results, which is run off to harden in molds. This resin in pure form finds limited use in the production of artificial amber articles, although the main supply of material for this purpose is produced by a different method. With a further application of heat to the digestor, a heavy viscous product results, which is likewise run off to harden in molds. This is the resin for molded plastic products. It represents an arrested reaction, which is completed in the molding operation, where it gets its final "set" under heat and pressure. To prepare the resin for use, it is ground to a powder and mixed dry with the filler, in most cases wood flour, to form the compound. Special fillers may be used for specific purposes, such as mica for additional electrical resistance, asbestos for additional heat resistance, etc. While the filler may

run as high as 70 per cent of the compound, the ordinary mixture is about 50 per cent.

In molding, the compound is charged into a heated mold, which is closed in a press and further heated until the material becomes plastic enough to flow, filling the mold and allowing the parts to come together. Excess material flows out in the form of a flashing at the joints of the mold. The plastic must be held under pressure a short time until the material cures, at a temperature of 350 deg. F. The usual molding pressure is 2,000 lb. per sq. in. The work may be ejected while still hot, without danger of deformation, because the plastic is infusible, or thermo-setting, that is, in the molding process it undergoes physical and chemical changes which permanently fix its shape and size.

While the compound is occasionally used in powdered form, a great depth of mold is required to accommodate the loose bulk. It is therefore customary to perform the powdered material into tablets of the proper size by pressing cold under a pressure of from four to six tons. The mold depth may be reduced from two and one half to one, by molding from tablets instead of bulk material, and loading of molds is much simplified.

Phenol-formaldehyde compounds are applicable to a wide variety of uses, owing to their many desirable physical properties. The products have good mechanical strength, high electrical resistance, and considerable heat resistance. They may be produced in colors, with good surface finish, are resistant to many chemicals, and may be molded to close limits. The shrinkage of 0.006 in. per inch, found in stripping hot, may be reduced to as little as 0.002 in. per inch, if the work is chilled. This feature makes the material especially desirable in the molding of mechanical parts.

Many Molding Compounds in Active Use

While at the present time probably a large bulk of the mechanical parts produced by molding are made from phenol-formaldehyde condensation resins, there are nevertheless many other molding resins, having varied mechanical properties, in active use. The phenol-formaldehyde resins have the disadvantages for some purposes of brittleness and difficulty of machining. Producers have varied the products, to obtain qualities desired for particular purposes, by varying the method of reaction, by adding softeners such as glycerin, by substituting furfural or other substances for the formaldehyde, or by changing to entirely different raw materials such as cumerone. One of the largest producers of molded mechanical parts employs a condensation resin made by the reaction of glycerin and phthalic-anhydride for some classes of molded articles, and a phenol-formaldehyde resin for other articles. The time is apparently approaching when the parts designer will have as much latitude in choosing a suitable synthetic resin for his molded parts as he has in the selection of alloys for the metal parts. Fortunately, also, the methods of testing the mechanical properties vary very little from those used in testing metals, and no special inspection department is required to assure the proper selection for the purpose.

How Can Machine Builders Best Designate the Proper Type of Motor?

By Tom Addison

THE situation regarding motor data has always been more or less aggravating to the users of machine tools as well as to the builders. Nevertheless, there is less confusion regarding motor applications at present than at any previous stage in the history of motor application.

Progressive machine tool companies are providing all auxiliary motors, for rapid traverse, elevating, work heads and various other uses, with the most suitable controls and are including this equipment in the original purchase price of the machine, leaving only the main motor, or motors, to the choice of the purchaser. This method helps greatly in eliminating annoying and expensive delays for both parties.

Nevertheless the machine builders must have certain definite information from their customers regarding current and voltage. These factors are variable in many ways, as we all know, and may include the following: maker of motor preferred; A.C. or D.C. current; if A.C., what cycles and phase; anti-friction or sleeve-type bearings; type of control. All these factors must be known and should be obtained at the time quotations are requested. Hence it is proposed that customers requesting quotations furnish at the same time their preference as to the motor manufacturer and also the information just listed.

This information definitely decides on the motor to be used from the point of view of the machine builder who is then in a position to furnish prices in his quotation for the various type of motors and their control. Such a procedure prevents salesmen from neglecting motor information after the order is signed, and at the same time opens up the old question as to who should buy the motor. It also helps to eliminate complaints from the user, helps to standardize the product of the maker in many ways, and finally aids in securing better delivery.

The writer favors the complete motor equipment being furnished by the machine builder. If the above points are settled, the points in favor of this method are as follows: the machine in most cases can be fully wired and tested before shipment, excepting perhaps in cases of special voltages and phases; all the customer has to do is to connect wiring, all other annoyances and expenses being eliminated; possible saving of cost in shipment of motors; elimination of possible errors in mounting of motors and control mechanism; better delivery; uniform painting of machine and motors, a matter of appearance that is being stressed nowadays.

The above list gives a few of the major factors in favor of the machine builders buying the motor equipment complete. The desirability of motor standardization is a question that can readily be raised in cases of this kind. Because of the increasing use of anti-friction types of motor bearings, another overall length has been introduced, causing an extra factor that must be taken into account.

Finally, local agencies of motor manufacturers in the machine tool districts will be better acquainted with the requirements of each company and this co-operation will give the machine builder a good opportunity to obtain the best and latest motorized features.

Finishing Metal Toys

By W. W. Burden

Eleven colors are used in giving sales appeal to a variety of mechanical toys, including automobiles, airplanes, trucks and scooters

IT IS easy to think of toy making as one of the cottage industries, or in terms of the small shop manned by craftsmen of the old school blissfully ignorant of blueprints, time studies and mass production. Such is still the order in parts of Europe, but in this country we make our toys in much the same manner that we manufacture our automobiles and build our locomotives. Toy making is a modern industry in every sense, using modern industrial tools and production equipment. It is an industry that is developing at the rate of approximately $5,000,000 per year.

The production curve for the toy industry, however, is far from smooth, this feature being more pronounced than in practically any other branch of manufacturing. The early months of the year are comparatively inactive, with production hanging close to the zero axis. By June the curve starts to rise, and, throughout the latter half of the year, each succeeding month shows a larger increase until the peak is reached in November. The curve drops off rapidly from this peak, approaching zero by January first.

In the finishing of upwards of 150,000 toys per month averaging eleven separate parts per toy, progressive methods are essential. The author describes the operations and layout employed in one large plant, and how other work is used to level the hollows of a seasonable business

Another important factor in the production set-up is the rapid changes in toy design. Styles in toys are almost as changeable as they are in automobiles, and also quite as colorful.

The Murray Ohio Manufacturing Company of Cleveland has gone a long way toward solving the production problems peculiar to the toy industry. Its organization and equipment are flexible. Changes in production are made quickly and with practically no lost motion. Production schedules can be rapidly increased as the toy season advances. During the early part of the year when toy production is light, excess plant capacity is utilized in the production of other commodities.

In October this organization shipped 151,500 toys, each unit of which had, on the average, eleven separate parts. This production runs entirely to the pressed metal toys finished in baked enamel, and includes wagons, automobiles, airplanes, trucks and scooters, fabricated from 22-gage black sheets, except for the under-gear and chassis which is, for the most part, $\frac{1}{8}$ in. band iron.

While there are a number of interesting points in the forming operations, this discussion will be limited to the finishing practices employed.

As a sales feature, color is decidedly important; hence a reasonably wide range of colors is used in finishing toys. The company in question uses eleven, red, blue and black having the widest application. The under-gear and chassis of the toys are finished in black, the body and superstructure receiving the colors. A comparison may be had from color records, which indicate that 30 per cent of the total production is in black, 35 per cent in red, and that the remaining 35 per cent is distributed through the remaining colors, such as blue, yellow, tan, brown, gray, green and orange, quite a large range.

Toy parts coming from the stamping presses or subassembly are delivered to a continuous washer, where all oil, grease and dust are removed. The parts to be cleaned are laid on the woven-wire conveyor belt of this machine, traveling at the rate of 38 in. per min. They are first brought under jets of hot cleaning solution and are then rinsed by another battery of jets discharging clean water at a boiling temperature. In the drying compartment of the machine immediately following the rinse, all moisture from the wash is driven off the parts by a temperature of approximately 600 deg. F. The double-jet gas burners located just beneath the open conveyor belt and discharging toward the entrance end of the drying compartment, furnish the heat for this operation. The clean, dry parts are taken off the washer belt, loaded on racks and rolled into the oven-room for finishing.

The oven-room is 120 ft. long, 28 ft. wide, with the lower side of the ceiling beams 12 ft. 6 in. above floor level. The greatest dimension of the room is east and west, with the north wall constructed almost entirely of steel sash windows.

A hollow tile partition separates the oven-room from the rest of the plant, a safety precaution to localize any blaze in case of accident. The oven-room has a double fire door at either end. The discharge end of the washing machine is just outside the west oven-room door, while the entrance ends of the ovens face the same door. The ovens are placed side by side, the black oven against the south wall.

Just beyond the east door of the oven-room are located the final assembly and shipping department. The product, then, moves in one direction from the press room to the shipping department, passing through the washer, the ovens and the final assembly. Any touch-up work, transfer work, or striping, is done by hand in the final assembly. All colors used in these operations are quick air-drying lacquers.

The ovens were designed on the basis of the following

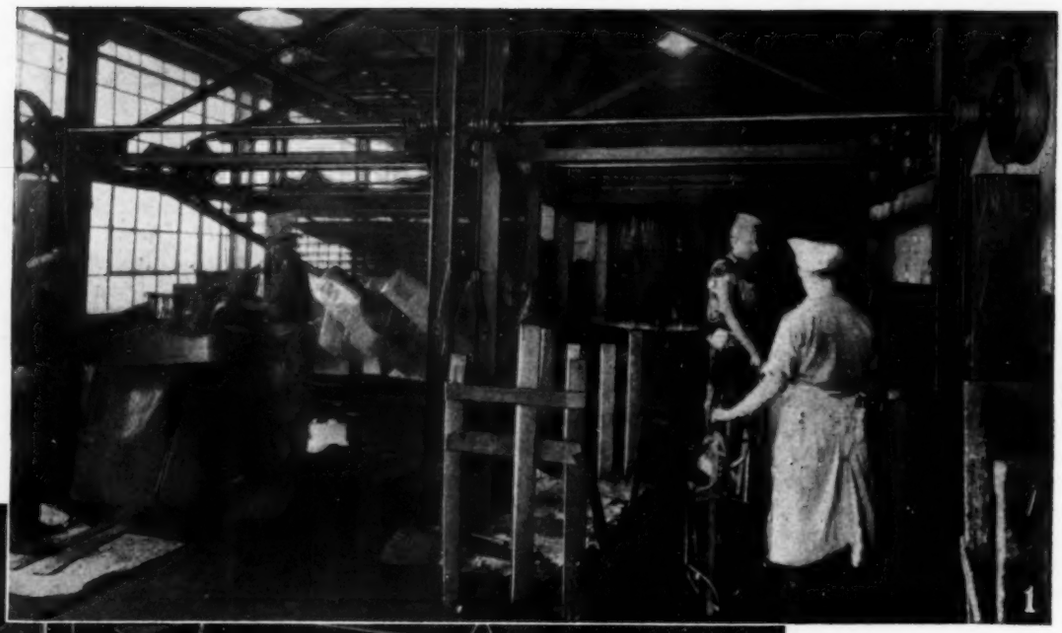


Fig. 1 — Loading the oven on the right for black work, and the one on the left for color work. Black is used mainly for the chassis, which is largely made of band iron

Fig. 2 — A close-up of the loading end of the oven for color work, showing the dipping tank and draining board

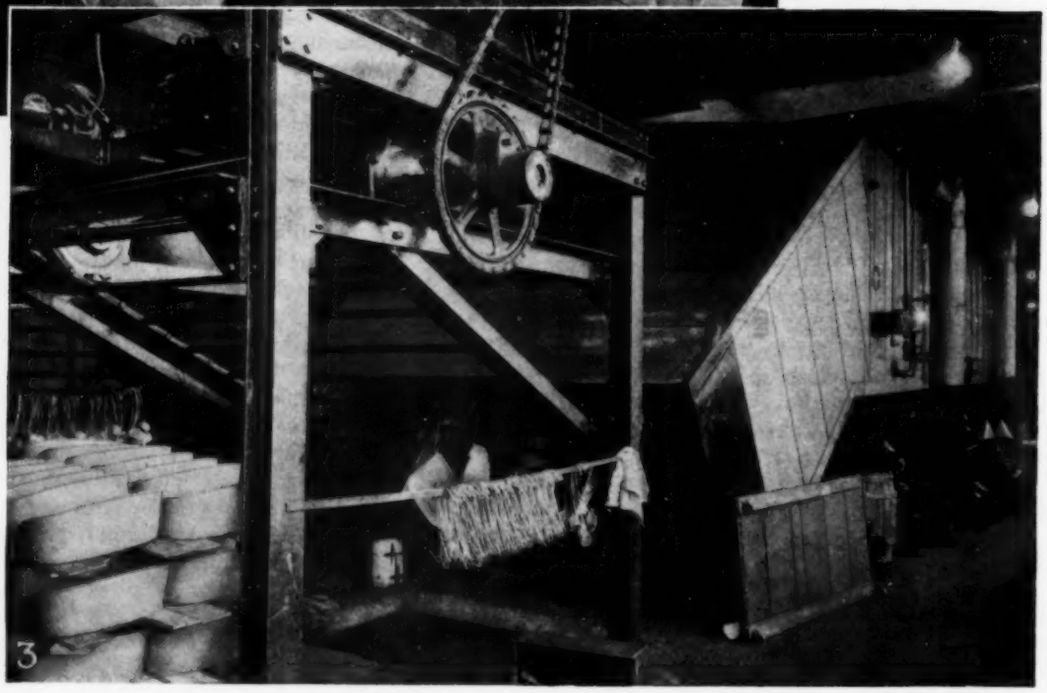


Fig. 3—Discharge end of ovens, the color parts being on the right and the black chassis parts on the left

as the production that can be obtained in a single day:

800 wagons
600 automobiles
400 scooters
800 small toys
780 miscellaneous toys.

This represents a total day's production of 3,380 assemblies for a period of 20 hr. During the month previously mentioned, when the total output was 151,000 units, the working day was increased to 24 hr. Correcting for the increase in length of working time, gives a design rating of 118,300 units for 30 days on a 24 hr. basis. Thus during the record month, the finishing department was working at 127 per cent of rated capacity. The production volume for November of the current year is expected to run 175,000 units, or 140 per cent of rated capacity.

From the typical day's production schedule it will be noted that frequent changes in class of product are necessary. That carries with it the necessity for more or less frequent changes in color, which introduces a problem, for all parts are dipped, and the lack of space precludes the use of more than one dip tank. Consequently, when a color change is made, it involves emptying the dip tank, cleaning the tank and drain boards and refilling the tank with the new color.

By covering the drain boards with an oil-resisting paper, the change is made by merely tearing off this paper covering and substituting fresh paper. The remainder of the details have been worked out to a point where the entire color change is now being made in 15 minutes.

The ovens used to bake the enamel finishes are two single-compartment continuous-conveyor horizontal air-sealed units; the oven used exclusively for colors is 8 ft. 6 in. wide x 7 ft. high x 57 ft. long. The oven used for the black-coat work has the same cross-section but is 37 ft. long. In both units the insulated steel panel construction with telescopic joint is used. All panels are made up of copper-bearing steel and special insulation.

Natural gas (900 B.t.u.) is burned in three full-length U-type indirect heaters, provided with preheating fresh-air jackets. Full-length pipe burners are used in these heaters.

The temperature of the ovens is regulated by automatic temperature controllers, operating gas valves. The relays operate on 110-volt alternating current.

Baking conditions for the several colors are varied by changing the operating temperature. The conveyor speed in both ovens is kept constant at 13½ in. per min. The temperature scale that experience has indicated gives the most consistent and economical results is as follows:

Black	450	deg. F.
Red	260	" "
Orange	250	" "
Green	250	" "
Blue	240	" "
Gray	240	" "

Both ovens are equipped with mechanical draft and a circulating system. Air is furnished in each case by a 25-in. steel-plate exhauster, belt driven from a 1-hp. 1,200-r.p.m. motor. Each oven has an individual outside stack.

The conveyors are double roller-chain units, running on angle tracks. The chains are spaced 7 ft. on centers, by 1¼-in. steel pipes. A 1-hp. 1,800-r.p.m., 440-volt, three-phase, 60-cycle motor drives the conveyor through a Reeves transmission and silent chain to the head shaft. A counterweight take-up maintains the chain tension at the desired amount.

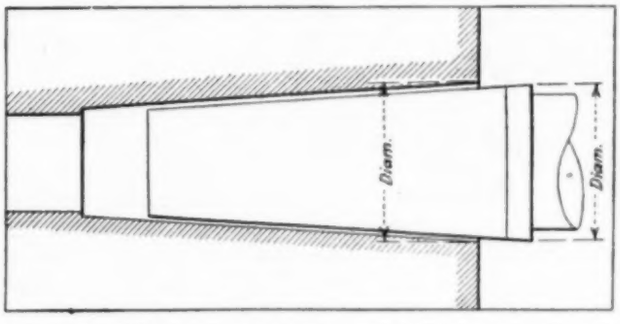
The labor used in the washing and finishing operations, when production is running high, is as follows: One man trucking and one man loading the washing machine; two men unloading and trucking washed product to the ovens; one man on each oven dipping and loading; two men unloading ovens and one man trucking finished parts to final assembly; one man on touch-up and striping; and two men handling assembly. This is approximately the same number of men formerly used with a battery of cabinet-type ovens. With the present continuous ovens approximately 62½ per cent more work can be turned out, representing a saving of between 25 and 30 per cent.

As an instance of baking speed, a check was made on the time required to run through an order of 50,000 display panels ordered by the Chevrolet Motor Company. These were pressed metal boxes 27 in. x 24 in. x 4 in. finished with one coat of black japan. Each part was hand-dipped, and the job run through the oven at the rate of 1,000 per hour.

The Standard Taper Problem
Discussion

By E. H. Ingram
Birmingham, England

REFERRING to the article by F. Trevor Daniel under the title given above, on page 831, Vol. 69, of the *American Machinist*, I would like to mention what I consider a weak point in his dimensioning. Mr. Daniel suggests that the small diameter of the taper on the



The author's method of dimensioning tapers

shaft and the large diameter of the taper in the socket be given. By this method, trouble is bound to arise, whereas if the large diameter of the taper on the shaft and in the socket be given, as in the illustration, it will be unnecessary to calculate this dimension for either of the members.

Another point in favor of this method is that in the majority of cases there will be a shoulder on the shaft, which should be a definite distance from the face of the socket. It is obviously better to give the dimension at the larger diameter of the taper (which coincides with the face of the socket) than at the small end, and to put a limit of accuracy on the length of the taper, which would not otherwise be done.

Discouraging Rush Orders

BILL HOLLAND was in the office of the Miller Screw Company with the manager, Harry Parks, when Jim Holt, the production man, dropped in with a red "rush" ticket and a grouch.

"You look worried. What's the trouble now, Jim?" asked Parks.

"It's these blasted red tickets, Mr. Parks. They upset schedules, put us in bad with regular customers, and add a lot to costs. I can't see why we get so many of them lately."

"Let's see what Tom Black has to say about it. He's the sales manager, you know," said Parks, turning to Holland. In answer to a ring Mr. Black appeared at the door.

"Jim thinks you're giving him too many rush tickets, Tom. Says they muss up production, delay regular orders, and cost real money. How about it?"

"I know they are a nuisance, Mr. Parks, but what can I do? Here's an order from an old customer. They tell me they must have these parts at once. It's the Brownell Company, you know, Mr. Parks."

"Yes, I know them, Tom, and I'm getting sick of their high-handed methods of ordering. They are the birds who print on their purchase forms —'Acknowledge this order immediately, stating definite shipping date. At once, or as soon as possible, will not do'—and then demand a three-day service on a handful of small, special stuff. We've got to put some backbone into our end of the game, Tom, and tell them where they get off."

"But we don't want to lose their business, Mr. Parks."

"Of course not, Tom, though it sometimes pays to lose an order, I guess. If it's costing us real money to sandwich their orders in ahead of others, as Jim says, perhaps we'd better take a chance at losing them. What about it, Mr. Holland?"

"Rush orders are always a problem, Harry, and the exasperating thing is that they are so often unnecessary. People who fail to anticipate their needs shouldn't expect to get in ahead of those who do. Too many wait until the last minute before committing themselves, and then want delivery 'yesterday', as the saying goes. I agree with Jim that the rush ticket idea is apt to be overdone."

"Just how can we avoid it, Mr. Holland?" said Tom. "Customers demand immediate service, and we've got to give it to them."

"Where machines are built on order, some concerns deliver everything in the sequence in which the order was received, unless, of course, the schedule permits a rush machine to be shipped without delaying anyone else. Where machines are built in lots, it costs real money to rush out a few ahead of the regular schedule, and any customer who demands this might be told of the extra cost, and invited to pay it, if the early delivery was worth that much to him."

"But some customers don't mind waiting and others do, Mr. Holland."

"If," said Holland, "you are in line for tickets at the box office and you are in no hurry, you are very willing to let someone who is in a rush step in ahead of you. But if he tries to elbow in without being decent about it, you resent it no matter how much time you have. Most customers are the same. And I know of no better way to cure these 'last-minute-order' birds than to tell them they will have to take their turn. If they demand a date, make it late enough to play safe with your other customers. Very often, demands of this kind are like those from the loud-mouthed customers in a restaurant, who think they have to yell to get immediate service. We are all apt to do more for the considerate man. The only way I know to curb the 'rush-order' habit is to let the firms know that we can't interfere with other customers because they delay too long in placing orders."

Executives are invited to discuss the problem involved in the foregoing case. They are also urged to use this department to air their own problems. A letter to the Executive Forum Editor is all that is needed.

Idea Submitted by Charles S. Hazard

EXECUTIVE FORUM

Discussion

Day Work or Piecework?

Day work, without an incentive, is a costly method of wage payment. To get maximum production and low costs under a day-wage system, conveyors are of definite service. They form pace-setters; each task must be performed in so many minutes, or the work has to come off of the line. However, the real name for such a system of operation is not day work, but task work.

The disadvantage with a conveyor is that individuality is not brought out. Where men have been working on jobs exactly alike, I have seen one man make fifteen per cent more than another. You cannot set your conveyor for this type of man, but you can speed it up to the point where you find some certain section, or some one man, is always behind. After correcting this condition you can again speed it up, and nobody knows that you are doing so unless they check up on the production.

With piecework, if a job is timed right and a correct rate is applied, this rate should stand as permanent. Just because a certain man happens to make ten or fifteen per cent more, is no sign that the piecework price is wrong. If the men know that, once a piecework price is set, it is good for a year or more, they will give their best output, willingly. The so-called unfairness in straight piecework is that at times we find an unskilled, but clever, young man making more money than the skilled operator, due to his adaptability on that one particular job.

—A. C. NOLKE,
Dodge Manufacturing Corporation.

Some firms have increased production by installing a piecework or bonus system, and found it profitable. Harper was incorrect when he said, "There's something wrong with the management when piecework gets more production than day work." But, taking into consideration the increased cost for timekeepers, and the increased number of rejections which any piecework or bonus system is sure to bring about, it is doubtful if the cost per unit is decreased.

This cost can usually be kept just as low, and sometimes lower, with straight day work, especially where accuracy of workmanship is important. With good management, day work is the best system, since piecework means increased overhead. —W. J. OWENS.

It is possible to get a higher output by means of day work only when the work is subdivided into a number of operations which all take exactly the same time, so that the rate of production is the same at all places, and a continuous stream of units is kept flowing. Conveyors are excellent pace-setters. Where they are installed, the men have to accomplish a definite amount of work in a given time. As the Ford Motor Company's experience proves, they work more quickly if they know positively the amount of work that must be done.

For three reasons I believe the day work system to be best: (1) The pace is no longer set by the men, but by the management, which means increased production, and working the machines to their highest degree of efficiency; (2) Parts and materials are always in motion, resulting in quick turnover; (3) Inventories of stock and raw materials are reduced. For maximum returns, under the day work system wages should be as high as under the piecework system.

—FRED ERKELENZ.

The "Can't Be Done" Man

Pass the job up as being impossible and then watch someone come along and do it! How often this has happened! A man was in line for a foreman's position on development work in a certain large plant. Frequently, when the engineers had an idea to develop, he would say "It can't be done." This man is still at the bench; someone else got the job. Men of that type are obstacles; they hold the plant back.

If Baxter wants men that are willing to try new methods, he certainly is entitled to them, because he will be responsible for the new plant, and his executive ability will be judged by the type of men with whom he surrounds himself. It is hard on some of the foremen, with years of experience behind them, to pass them by when a better job is in view, but nowadays it may be necessary for efficiency. —P. H. PEARSON.

The Man Over Fifty

I am in the forty-years-of-age class and have been an executive continuously since the age of nineteen. From my experience, the majority of dependable "key" men in any progressive organization are those above the age of fifty years.

Any man, whether he be thirty-five or sixty-five, who is physically and mentally active, who has acquired years of experience in his particular field, who continues to be progressive by subscribing to literature pertaining to his trade or profession, is an asset that any organization would be short-sighted turning down on account of age. However, there is an age limit beyond which a man cannot continue to be efficient on

heavy manual labor, or where dexterity is required. This limit is variable and depends entirely upon the individual under consideration.

Therefore, in my opinion, the requirements of each job should be classified and the employee obliged to meet the requirements of that particular work. The experience, ability and physical fitness of the man should be the requirements for a position, and age of secondary consideration. Any organization pursuing this policy and having a pension system, should, of course, protect itself by incorporating necessary restrictions in its pension plan.

—H. M. BADGER, *General Superintendent, Stanley Insulating Company.*

Finish on Machines

While good finish is not necessarily a proof of accuracy, it is a sign of care. So seldom does accuracy go with roughness, that a poor finish is naturally associated with lack of accuracy. First impressions of this character have considerable influence from the standpoint of sales.

A good finish on a machine usually means that the machine can easily be kept clean. In the case of textile and certain other machinery, rough surfaces collect fluff and dust and increase the fire risk, so that for this reason a good finish is desirable. Finish may also make a considerable difference in the ease of working the machine; a rough handle may decrease the speed of operation.

Appearance influences the attitude which the operator takes toward the machine or tool which he is handling. A foreman saw a workman using, as a hammer, a gage which had a good finish only on the gaging points. Walking up to him, he showed him a cheap watch and asked, "Would you use this as a hammer?" "Of course not," was the reply. "Then why use the gage that way? It costs more than this watch, and you are doing just as much harm to it as you would to the watch. Still worse, the damage to the gage ruins its accuracy and means a lot of spoiled work." The same man would not have misused a well-finished gage. Its value would have been more apparent, and also he would realize that hammering would show up on the good finish and make his misdemeanor visible.

—A. F. GUYLER, *England.*

When the Rush Comes

It is admittedly difficult to speed up work by fifty per cent, and the problem of how to do it depends so much on the nature of the job itself that it is difficult to generalize. To reduce the time required to complete a thousand calculating machines from six months to four months is quite different from doing the same in the case of ten large and very complicated automatic machines, because it is almost impossible to speed up design.

Large and complicated patterns are best constructed by the patternmaker in consultation with the foundry foreman, but many of the smaller ones are sufficiently simple to be farmed out. Work can be speeded up on existing machines, possibly thirty per cent, by using Stellite or tungsten-carbide alloy in place of high-speed-steel tools. Where there is no bonus scheme in operation, the introduction of a substantial individual bonus on all work turned out above the usual average should provide a further five to fifteen per cent increase in production. The cost of the bonus would be balanced by the reduction of overhead per piece. Experienced men can be put on an extra shift and their places on the dayshift taken by new men whose work can be kept under close supervision. In most machines at least thirty per cent of the parts, such as shafts and gearwheels, are of standard design, can be held to close limits by gages in general use, and can therefore be bought outside.

The erection of complicated machinery is the most difficult type of work to speed up. Assuming that all unnecessary fitting has been eliminated, the only recourse available, apart from overtime and the absorption of fresh labor, is providing erecting jigs and substituting mechanical operations for hand work wherever possible.

—H. JAMES, *England.*

Should Buyer Specify Design or Results?

If the buyer knows what kind of equipment he wants, designs it and takes the responsibility for it, the only objection the machine tool manufacturer can have to building it is that the purchaser may some time tell who made it. Then the builder is advertised, or damned, as the case may be. On the other hand, if the builder is to be held responsible for the working of the machine, he must design it, or the design must be subject to his approval. This, however, is only one aspect of the case.

If the manufacturer has spent years designing and building his line of equipment, one of two things has happened. He has either fallen into a rut from which he is unable to emerge, or he has benefited immensely from his experience, as his prospective customer has not. In the first case, it is doubtful if he can even follow the customer's design intelligently, while, in the second case, the customer cannot afford to dispense with the knowledge which the builder has acquired. Unless the machine is so new and unlike others that no experienced firm can be found to build it, the buyer will do well to stop and measure the risk he runs if he tries to design his own machine.

—E. H. FISH.

Conversion of Hardness Numbers

By Alfred Heller

Secretary and Treasurer, Hercules Electric Steel Corporation

Varying degrees and distribution of cold-working are produced by the Rockwell and Brinell hardness measurements because of different shaped indenting tools

IN ORDER to explain satisfactorily the tests of the first part of this article which established the fact that a single conversion chart cannot be obtained for all steels, it is necessary to show that cold working of steel increases its hardness in a variable way depending on the initial hardness, and to show that when the direction of the flow of steel under pressure is changed more or less suddenly, an increase in the cold-working effect will be experienced.

During the past few years the cold-press finishing of steel has been developed to a marked degree. All kinds of small machine parts and tools have been made successfully by cold pressing soft annealed steel between dies of suitable design. In many cases, tools made of cold-pressed steel are increased in hardness and strength to such a degree that subsequent heat-treatment is unnecessary. E. V. Crane has shown that, up to about a 50 per cent reduction of diameter, cylindrical steel bars increase in compressive strength practically in direct proportion to the percentage of compression. After the 50 per cent point is exceeded, the resistance to compression mounts rapidly.

Those engaged in the manufacture of dies for the cold working of steel know that the first part of a die that fails because of excessive pressures is a part where the shape of the surface is such as to cause the greatest change of direction of the flow of the steel being worked. Rounded corners and bottoms of depressions are always affected first, as evidenced by cracks at these points. The cause is a slow but continual grain slippage. When the slippage exceeds the breaking strength of the die, fracture results in the form of a small surface crack.

Steel, when subjected to sufficient pressure to cause it to flow, does not act like a true liquid, but the pressures are concentrated and multiplied on those surfaces which produce more or less abrupt changes in the direction of the flow of metal.

To illustrate the effect of cold working of steel, two Brinell impressions were made on the 1.30 per cent carbon G-series of test blocks, which varied in hardness from C-68 to C-20. The center of each of these Brinell impressions was tested for Rockwell hardness, and the increase in hardness between the surface of the steel and the bottom of the Brinell impression was plotted in the curve shown in Fig. 6. The acceleration of the cold-working effect increasing hardness at about C-30 is to be noted.

Assuming the slip-interference theory of the hardening of steel to be correct, then this increase in hardness is due to comparatively large grains of unworked steel breaking up into smaller grains due to cold working. Therefore, it can be concluded that steel, when caused to flow under pressure, is increased in hardness and that the percentage of increase will vary with the original hardness of the steel as well as with the amount of cold work performed. It can also be concluded from the consideration of the failure of dies used in cold pressing steel, that the pressures, and therefore also the cold working effect, will be increased when a surface suddenly causes a change in the direction of the flow of the steel.

As all deep-hardening steels plot themselves into a single conversion curve irrespective of analysis, as shown in the first part of the article, it can be concluded

The second part of the article. The conclusion will appear in an early issue.

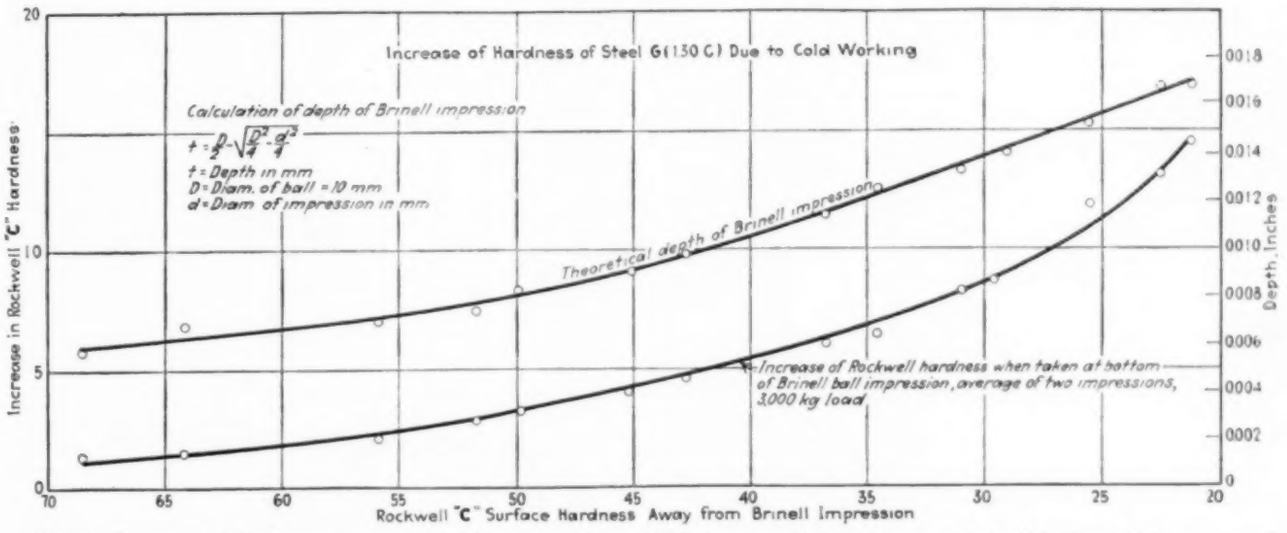


Fig. 6—Increase of hardness, as measured by the Rockwell "C," due to cold working by a Brinell ball on 1.30 per cent carbon steel is shown by the lower curve

that the increase in hardness due to cold working is independent of analysis.

As the size and shape of the indenting tools for the Rockwell and the Brinell methods of testing are entirely different, varying degrees of the cold-working effect will be experienced in each case. Moreover, it can be seen that the amount of cold work and, therefore the hardness, will vary at different points within the surface of either a Rockwell or a Brinell impression. The Rockwell cone is not a true cone, but is a 120-deg. cone with a rounded apex. The rate of change in the direction of flow of metal will be different at the rounded apex than along the 120-deg. slope of the sides of the cone. When a Brinell impression is shallow, as in the case of a test made on hard steel, the slope of the impression varies little with small variations in hardness. However, as the steel becomes softer, a point is reached where small variations in hardness cause decided changes in the depth and slope of the impression. When this condition begins to manifest itself, comparatively small variations in hardness cause decided changes in the cold-working effect.

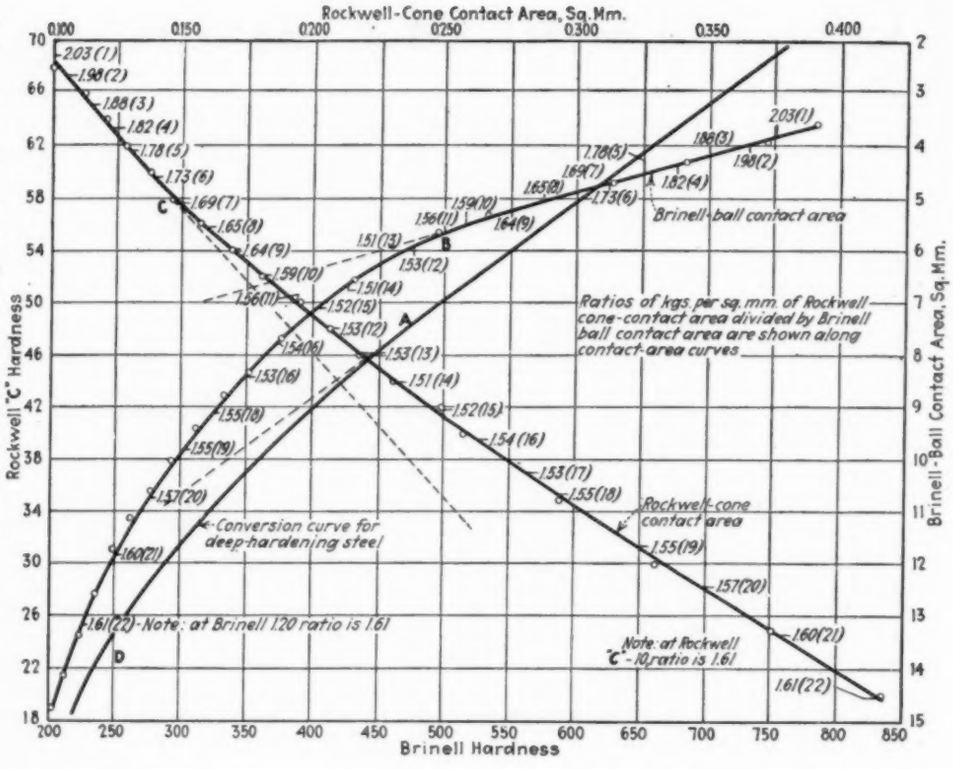

Rockwell-Cone Contact Area, Sq. Mm.
Rockwell "C" Hardness
Brinell-Ball Contact Area, Sq. Mm.
Brinell Hardness
Brinell-ball contact area
Ratios of kgs. per sq. mm. of Rockwell-cone-contact area divided by Brinell ball contact area are shown along contact-area curves
Conversion curve for deep-hardening steel
Rockwell-cone contact area
Note: at Brinell 120 ratio is 1.61
Note: at Rockwell "C"-10 ratio is 1.61

Fig. 7 — Conversion curve for deep-hardening steels superimposed on a plot of Rockwell cone contact-area vs. Rockwell "C" hardness; and a plot of Brinell-ball contact-area vs. Brinell hardness. The figures show the ratio of Rockwell and Brinell unit pressures, and are followed by the test number in parenthesis

Therefore, it can be seen that the increase in hardness due to cold working will not only vary with the depth of the impression for the two systems, but will also vary because of changes in the direction of the flow of the metal at different depths of impression. Knowing that the shape of the indenting tools causes the steel tested to increase in hardness by varying amounts, some interesting conclusions can be arrived at by studying the Rockwell-Brinell conversion curve.

In Fig. 7 the conversion curve for deep-hardening steels is superimposed on a plot of the area in sq.mm. of the Rockwell cone in contact with the steel, plotted against Rockwell numbers, and also the spherical contact surface of the Brinell ball plotted against Brinell numbers. Knowing the load in each case, and the area over which it is distributed, the average pressure per sq.mm. can be determined. These pressures are shown in Table III. The ratios of the Rockwell pressures divided by the Brinell pressures are also shown. These ratios are shown in Fig. 7 along the surface contact curves, and at equivalent hardness values for the two systems. It is to be noted that pressures shown are average pressures.

It is evident that the average unit pressure of a Rockwell impression is greater than the average pressure for a Brinell impression of equivalent hardness. The difference is greatest at C-68 where the average Rockwell unit pressure is double that of a Brinell impression. From previous considerations it can be concluded that the shape of the indenting tools causes this. Apparently, the rounded apex of the 120-deg. cone causes quick changes in the direction of the flow of steel with resultant increase in cold working, hardness and pressure. When point *C* is reached (see Rockwell contact-area curve) the area along the 120-deg. slope of the cone becomes relatively greater, and the contact curve becomes nearly a straight line with area proportional to hardness.

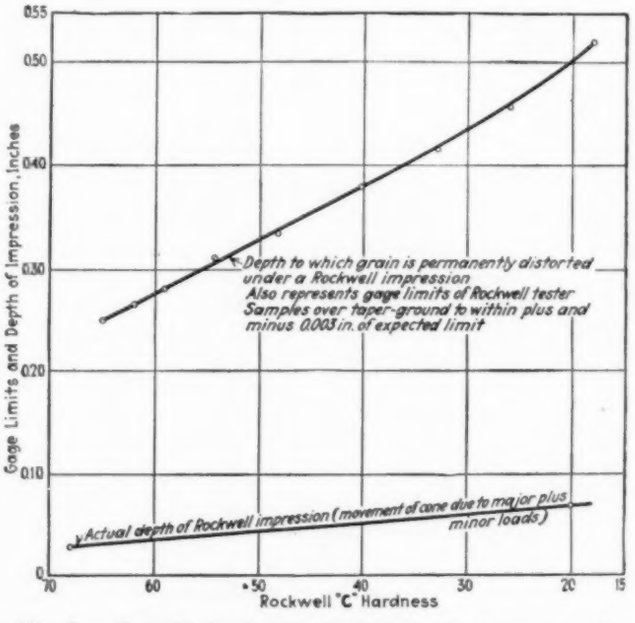

Gage Limits and Depth of Impression, Inches
Rockwell "C" Hardness
Depth to which grain is permanently distorted under a Rockwell impression
Also represents gage limits of Rockwell tester
Samples over taper-ground to within plus and minus 0.003 in. of expected limit
Actual depth of Rockwell impression (movement of cone due to major plus minor loads)

Fig. 8 — Gage limits for Rockwell test. Tests were made on 1.00 per cent carbon steel

Referring to the pressure ratios shown at different points along the Rockwell contact-area curve, it will be noted that they decrease from 2.03 at C-68 to 1.51 at C-41 when they slowly increase to 1.61 at C-20. At a value of minus C-10, figured from data published in the Bureau of Standards Technologic Paper No. 334, the ratio is still 1.61. As the Rockwell contact-area curve has no decided changes from C-44 to C-20, the Brinell contact curve must be referred to for an explanation of this reversal of ratios.

Up to point *B* the Brinell contact curve shows a uniform increase in area. After point *B* is passed the increase in area becomes accelerated. Therefore, up to point *B* the pressure ratios are varied only by the accelerated area changes of the Rockwell cone, whereas after point *B* is passed on the Brinell area curve the Rockwell changes are constant and the Brinell changes have become accelerated and are the cause of the reversal in the pressure ratios.

How these varying factors affect the conversion curve is shown at *A* on the Rockwell-Brinell conversion curve. With almost uniform variation of surface areas for both systems up to points *B* and *C*, the Rockwell-Brinell curve at first assumes a straight line. When the Rockwell area curve begins to show an accelerated change, the change in cold-working effect thus produced is at first neutralized by the Brinell area changes causing an approximately equivalent result as to unit pressures. However, after point *A* is passed on the Rockwell-Brinell conversion curve, the Brinell area changes are accelerated with the Rockwell area changes constant. This explains the break in the conversion curve from *A* to *D*. The indication is that from *D* at C-20 to minus C-10 the conversion curve would be a straight line as the ratio of unit pressures between the two systems is 1.61 at C-20 and also at minus C-10 as previously explained.

It should be noted, however, that the Rockwell cone is only accurately calibrated for hardness values to a minimum of C-20, and therefore softer steel than C-20 is likely to be tested incorrectly by the operator.

Table III—Results of Tests on the Cold-Working Effect of Rockwell Cone and Brinell Ball

Brinell Number	Average Brinell Pressure, Kgs. per Sq. Mm.	Rockwell "C" Number	Average Rockwell Pressure, Kgs. per Sq. Mm.	Rockwell Cone Contact-Area, Sq. Mm.	Rockwell Unit Pressure Divided by Brinell Unit Pressure
750	750	68.6	1,520	0.099	2.03
730	730	67.4	1,445	0.104	1.98
700	700	65.1	1,317	0.114	1.88
675	675	63.3	1,230	0.122	1.82
650	650	61.6	1,155	0.130	1.78
625	625	59.6	1,080	0.139	1.73
600	600	57.7	1,013	0.148	1.69
575	575	55.9	950	0.158	1.65
550	550	54.0	890	0.169	1.64
525	525	52.1	834	0.180	1.59
500	500	50.2	782	0.192	1.56
475	475	48.0	728	0.206	1.53
450	450	46.0	688	0.218	1.53
425	425	43.9	641	0.234	1.51
400	400	41.8	608	0.247	1.52
375	375	39.5	573	0.262	1.54
350	350	37.0	536	0.280	1.53
325	325	34.5	503	0.298	1.55
300	300	31.6	466	0.322	1.55
275	275	28.4	432	0.348	1.57
250	250	24.8	400	0.376	1.60
225	225	20.1	362	0.414	1.61
120	120	—10.0	192	0.783	1.61

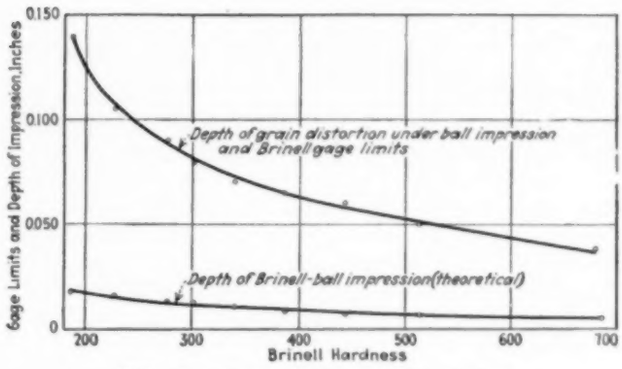


Fig. 9 — Gage limits for Brinell test

It can be concluded that variations in the slope of the Rockwell-Brinell conversion curve are caused by variations in the amount of cold work due to the difference in shape of the indenting tools of the two hardness testers. It can be further concluded that the rounded apex of the Rockwell cone increases the amount of cold work to a marked degree, causing high unit-surface pressures on hard steel.

The crowding of the metal displaced in an indentation hardness test causes the grain of the steel to be permanently deformed below, as well as on all sides of, such an impression. As a Rockwell impression is made on thin steel and the gage of the steel continually lessened, a point is reached where the impression shows as a dull spot on the back of the piece tested, and readings become low. This point where the readings are affected, very nearly marks the depth to which the grain of the

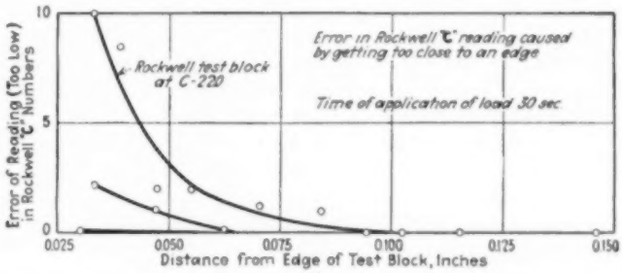


Fig. 10 — Error in Rockwell "C" reading caused by getting too close to an edge. Tests were made on 1.30 per cent carbon steel

steel is permanently deformed under a Rockwell impression. It does not exactly mark the point, but is the point where the steel anvil causes sufficient change in direction of flow of steel being displaced to affect the readings. For practical purposes it can be considered to be the depth to which the grain of the steel is permanently deformed. Fig. 8 shows this graphically, and was obtained by taper-grinding samples of 1.00 per cent carbon steel, one-half in. wide, within plus and minus 0.004 in. of the expected gage limit. This curve can also be used for determining the limiting thickness of steel that can be tested, without an error, for any given Rockwell "C"-scale hardness. The actual depth of a Rockwell impression is shown as the movement of the cone due to both minor and major loads.

In Fig. 9 is shown the same things for the Brinell test, with the exception that the theoretical depth of the impression is plotted instead of the actual depth as is the case with the Rockwell curve. The actual depth of a Brinell impression is somewhat less than the theoretical

depth because steel under pressure is not perfectly plastic and "comes back" somewhat.

When the Rockwell cone is used too close to an edge, a low reading results, and, on soft steels, often a decided bulging of the edge is noted. The extent of this error is shown graphically in Fig. 10. The Wilson-Maeulen test block at C-22, and two samples of steel *G* were used in these tests. It is evident that the Rockwell test causes decided lateral pressures, for at C-22 the center of an impression must be 0.095 in. from the edge so as to avoid affect on the readings. The width of the Rockwell impression at C-22 is about 0.025 in., or the center of an impression must be nearly four times its width from an edge at C-22 in order to avoid an error in such a Rockwell test.

Theoretically, the lateral component of the pressure figured by the law of the triangulation of forces is one-half the vertical pressure, or 75 kgs., and equivalent to this force applied at a distance equal to 0.707 times the slant height of the cone measured from the apex of the same, and equally distributed along the circumference of a circle around the cone at this point. Practically, it is hard to determine the magnitude of component forces, and the direction and points of application of equivalent forces because of the sluggish flow of steel under pressure, and the consequent effect of the changing of pressure and direction. However, from the foregoing it is evident that a large lateral force is acting in the case of a Rockwell test, and it will be shown from further tests that its equivalent force must act very close to the base of the cone taken on a level with the surface of the steel.

The Brinell test, with its comparatively shallow impression with gently sloping sides, develops a practically negligible lateral component which increases at first slowly, but at Brinell 500 (see Fig. 7 at *B*) quite rapidly. However, up to C-20 the Brinell value never approaches the relative Rockwell lateral component. Good practice, therefore, requires that a Brinell test be made about two and one-half times the diameter of the impression away from an edge or another impression.

It can be concluded that, for all Rockwell "C" hardness values, the Rockwell cone develops a relatively much greater lateral pressure component than the Brinell ball. It can also be concluded that the gage limits shown in Figs. 8 and 9 very nearly represent the limit of permanent grain deformation under a hardness indentation, the actual depth being somewhat greater.

Too Many Distractions—*Discussion*

By D. C. Wright

THE recent editorial in the *American Machinist*, dealing with the unsatisfactory arrangement prevailing at the average national meeting of a certain large organization of technical people, surely "said a mouthful," though I'm frank to say that, except as an illustration of a pretty general condition, it is unfair to cite this particular organization.

Except as an excuse for a lot of men to take a few days of vacation at the expense of their employing companies, the big association meetings are for the most part an utter waste of effort, money and time and should be abolished as a matter of efficiency.

In order that I may not be dubbed a chronic kicker, let me hasten to say that it is a practical impossibility to arrange a program of topics in such a way as to permit the varied interests of individual delegates in a large organization to be met without conflict.

Then, too, in an effort to cover as general a field as possible in the limited time at their disposal, the practice of limiting both the presentations and the discussions still further reduces the value of any item on the program.

A Suggestion

There does seem, however, in the writer's mind, a much better way of doing the job, though doubtless its attempted adoption would provoke a long and raucous howl from hotel and transportation people, to whom a natural gathering of any sort is as manna from heaven.

Anyway, here is one sufferer's suggestion:

First, we can assume that the program as laid out at one of these meetings, is made up of carefully-selected subjects. At least, as programs, the arrangement of topics is usually such as would appeal to a large following among any particular organization's membership.

Now, let us assume further that any authority capable of preparing a paper on a given subject has not only the familiarity with the topic, but also sufficient conviction with reference to the merits of the topic to be willing and able to discuss its points with interested listeners.

Then, since all papers, prepared for a gathering of the sort under discussion, are ultimately put into printed form anyway, why not permit each delegate to apply for copies of these papers in which he is interested, and arrange for the receipt, filing and replying to such questions or discussions on these papers, as a perusal of their contents might call forth from him?

Instead of a great gathering of men, brought together at an enormous outlay of time, money and hard work, which at best could only cover a portion of the items of interest to them as individuals or employers' representatives, a national meeting would develop into a clearing house of useful information on "live" topics, and a final transcript of papers and discussion would go to those entitled as members of delegates to receive them.

This is substantially the process now followed out, with the exception that as material is now published, it only covers the actual matter brought forth in the meetings, which is usually far from complete, owing to the limitations which schedule requirements place upon them.

Such a method as that suggested would automatically limit the discussions to interested parties, and presumably those most capable of constructive discussion, since the necessity of putting remarks into writing would deter the casual speaker, who merely likes to "have his say."

I am a member of the national society whose gathering was the basis of the editorial which called forth these few remarks. I have also been a consistent attendant during past years at the gatherings of both this and other organizations, but my recent experiences have reformed me.

For the future, I prefer to pay my fee, stay comfortably at home and on the job, and get as good a printed review of things as possible.

Development and Application of *WIDIA*

By Roger D. Prosser
Thomas Prosser & Son

Brief history of the development of this tungsten-carbide material and some practical considerations regarding its proper use in the shop

IT HAS been quite generally known for over thirty years that tungsten carbide is one of the hardest materials in existence. It was first produced by the French chemist, Henri Moissan, but its application to metal-cutting tools was extremely limited, due to its brittleness and porosity. Many cast compositions of tungsten carbide have since been tried, but all were brittle and far from homogeneous.

It will, therefore, become apparent that the possibilities of tungsten carbide for cutting tools will depend upon the ability to increase the toughness through special methods of alloying and manufacture. Credit for the original discovery of the possibilities of improving the properties of tungsten carbide through the addition of cobalt, must be given to scientists of the Osram Company, of Berlin. A tungsten-carbide alloy was produced which was called "Hartmetall" and which was considerably tougher than tungsten carbide itself, but which was not all that could be desired.

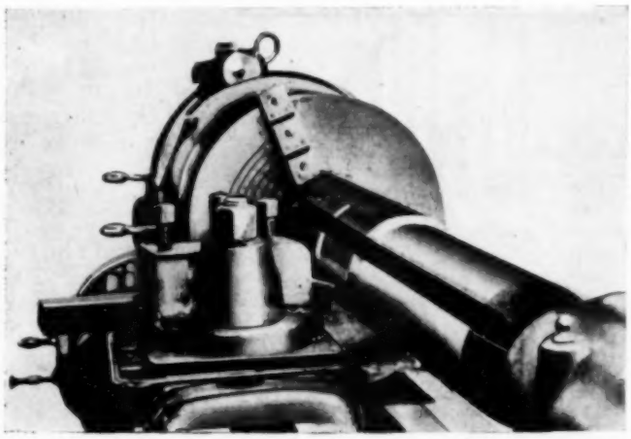


Fig. 1 — Slotted cast-iron test log being machined at 655 ft. per min. with a Widia tool. The slot produces 400 impacts per min. on the cutting edge

The Krupp Steel Works obtained the rights under the original patents and undertook extensive research for a tougher combination. It is possible to vary the toughness and hardness of tungsten-carbide alloys over wide limits by varying the proportions of the ingredients and the process of manufacture. Exhaustive investigations in the Krupp research laboratories finally resulted in the development of a process and composition producing an exceedingly tough and remarkably homogeneous material. This product, while attaining such great toughness, retained the hardness of the tungsten carbide to such an extent that Krupp named it "Widia" from the German words "Wie Diamant," meaning "like a diamond."

After leaving the laboratory, Widia was thoroughly tested in production in the workshops of Essen to make sure that it was out of the experimental stage before it was placed on the market in a commercial way. This was finally done about the end of 1926. Arrangements have since been made whereby several concerns in the United States are enabled to manufacture similar alloys on a royalty basis.

Widia is produced in the form of small tips for use as cutting edges for tools or as inserts for any part having to withstand wear or abrasion. Widia is made by forming the finely divided and carefully mixed components to the shape desired under powerful hydraulic pressure. It is then sintered in an inert atmosphere at high temperature, resulting in a very hard product which must be ground on special wheels developed for the purpose. The entire process of manufacture is very difficult, and the purity of the materials used and state of pulverization greatly affect the resulting product as the

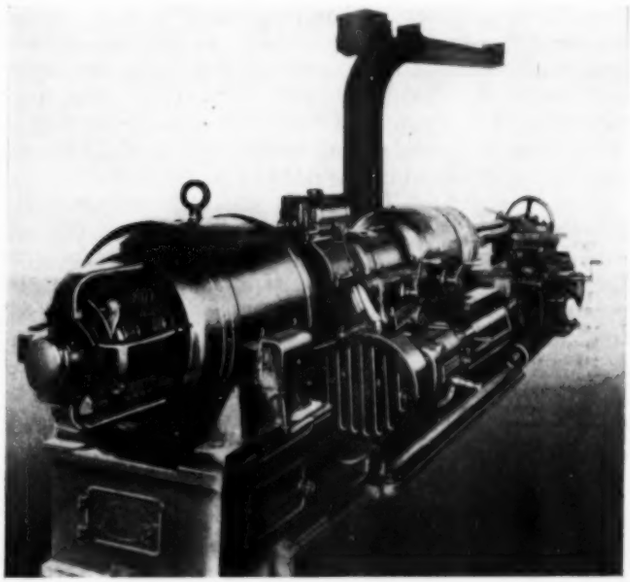


Fig. 2 — Powerful lathe developed in order to take full advantage of the cutting possibilities of Widia

Abstract of a paper presented before the machine shop practice divisions of the Plainfield and Metropolitan Sections of the A.S.M.E., March 19 at Newark, N. J.

finally divided pure tungsten carbide must be evenly distributed throughout the cementing matrix of cobalt.

One shop in this country that manufactures automobile parts has in use more than four hundred Widia tools. This shop has ordered an additional supply of tools sufficient to tool up every machine. When this has been accomplished, the production of the entire shop will have been more than doubled, according to the estimate of the manager, on the basis of the performance of the machines already equipped. This doubled production will be accomplished without any new equipment and without additional labor.

Another specific instance of speeding up production is in the manufacture of a transmission drum for a certain popular make of car. With the best alloy previously available, this drum, which is of iron cast in a permanent mold and very hard on the surface, was machined at a cutting speed of 190 ft. per min. With Widia this is being done at 592 ft. per min. The previous production time was 78 sec., whereas with Widia this part is now being made in 20 sec. In addition, the previous tool needed regrinding after every 25 drums machined, whereas the Widia tool only needed regrinding after every 100 drums machined. This was without change in equipment, other than the change to Widia tools and speeding up the machines. In the class of hard materials, such as chilled cast iron and manganese steel, previously almost unmachinable, Widia performs spectacularly. For example, 12 per cent manganese steel is being machined regularly at cutting speeds of 35 ft. per min., 0.2 in depth of cut, and 0.012 in. feed.

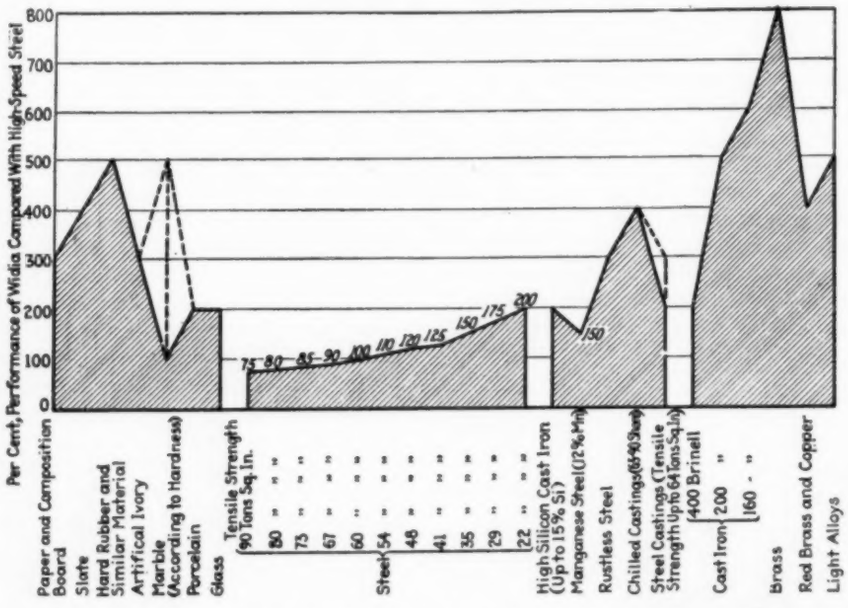


Fig. 3 — Diagram showing the possibility of greater output by the use of Widia at increased cutting speeds, but with the same size chip as is used with high-speed steel. The comparisons are based upon the highest performance of the best high-speed steel and hence show the minimum performance of Widia

A very useful field for Widia is in machining soft but abrasive materials. A particular application of this nature is in a large die-casting shop. The job is machining the fins from small aluminum die castings, and the greatest number of pieces that had ever been machined before the tool needed regrinding was 2,500. A Widia tool was put on the job, and at the last report had machined 45,000 pieces, had never been out of the machine, and the edge was still in good condition, producing a smooth finish on the work.

A manufacturer of bronze bushings is using Widia and reports that where Widia tools are in use, the machines have been speeded up to five times the previous speeds, and where regrinding was formerly necessary after every 15 pieces, it is now only necessary to grind the Widia tools after every 500 pieces.

Diamonds have recently been coming more and more into use for various operations in the machine shop, such as finishing bronze bushings in connecting rods, for machining abrasive materials such as hard rubber, bakelite, aluminum, bronze, and for other similar applications. When boring connecting rod bushings with diamond tools, it is possible to use a very high speed, producing an exceptionally true bore and fine finish. Special rigid machines, free from vibration and capable of the high speeds, must of course be used. Widia is now replacing many diamond tools, and these small Widia boring tools can be run at just as high a speed as the diamond tools, which is from 2,500 to 5,000 r.p.m., depending on the size of the hole to be bored. The cost of the complete Widia boring tools is only about one half to one third as great as that of the complete diamond tools of the same size.

In order to give an idea of the toughness and speed that can be attained when conditions are right, the following figures are given. These results are being accomplished daily on cast-iron test logs at the Krupp Works. Fig. 1 shows the work in the lathe. The pieces are about 12 in. in diam. with two cast slots, each $1\frac{3}{8}$ in. wide, as shown. With a Widia tool these pieces, which have a Brinell hardness of 200, are machined at a surface speed of 655 ft. per min., with a depth of cut of 0.059 in., and a feed of 0.036 in. The Widia tool is not injured by the intermittent service, which amounts to over 400 impacts per minute on the cutting edge. Under good conditions it has been possible to machine cast iron at cutting speeds in excess of 1,000 ft. per min. for long periods of time.

It is an interesting fact that the work remains comparatively cool when being machined at high speeds with Widia, instead of becoming hotter, as would be expected. A decrease in power required per pound of metal removed is also noted.

In the light of some of the figures mentioned above, it is obvious that cutting tools are again in advance of machine tool design, and many of the machine tool manufacturers here and abroad are busy designing equipment that will be able to make full use of the possibilities of Widia. Fig. 2 shows the powerful and rigid lathe which it was necessary to build for the demonstration room at the Krupp Works in order to be able to exhibit the full capabilities of Widia. At the present time, however, every machine shop is full of machines that are not being run to anything like their full capacity. They can be speeded up considerably, and there is usually plenty of power available. These are the places where

Widia can save money without the necessity of purchasing new machine tools.

Widia is only about half as strong as high-speed steel, and the maximum pressure of the chip on the surface of the Widia tool should be correspondingly less than the maximum chip pressure on the surface of a high-speed steel tool. Ordinarily the pressure on a high-speed steel tool is far from the maximum allowable, the principal limiting factor being the cutting speed. In these cases Widia tools can be used with the same feed and depth of cut, and at greatly increased cutting speeds.

In Fig. 3 is given in condensed form the increase in cutting speed that can be expected under the above conditions when machining various materials and when maintaining the same feed and depth of cut as usual. This table is based on the best performance of high-speed steel. In other words, it shows the minimum that can be expected consistently with Widia tools if conditions are reasonably good, and will be found a safe guide for ordinary use. These figures can be greatly exceeded under proper conditions.

When the chip pressure on the tool approaches the maximum allowable with the high-speed steel, it is necessary to make provision for a proper reduction in the pressure, if it is desired to speed up production by replacing the high-speed steel tools with Widia. This reduction in pressure can be accomplished by using finer feeds, or by the use of a different form of tool. A somewhat decreased feed will often permit the use of a greatly increased cutting speed. For heavy work, it is desirable, where possible, to use a tool whose cutting edge enters the work at an angle of about 45 degrees.

The clearance angle of the tool should be kept within reasonable limits, so that the cutting edge will be properly supported by the steel of the shank. In addition, a side slope or back rake—depending on the direction of cut—should be ground on the tool. Fig. 4 shows the recommended angles for planing or shaping. For this service, it is necessary that the tool be lifted from the work on the return stroke, otherwise there is danger of breaking off the fine cutting edge. This further emphasizes the necessity for supporting the tool edge.

It should not be concluded from the above that it is not possible to use heavy feeds and cuts with Widia. On the contrary, it is possible to take very heavy cuts under the proper conditions, even when the cuts are interrupted. For example, 0.35 per cent carbon steel can be cut at 100 ft. per min., 0.2 in. cut, and 0.16 in. feed, or at 200 ft. per min., 0.4 in. cut and 0.060 in. feed. Chrome-nickel steel, 3½ per cent nickel, 1½ per cent chromium, 140,000 lb. per sq.in. tensile strength, can be cut at 65 ft. per min., 0.16 in. cut, and 0.160 in. feed, or at 150 ft. per min., 0.4 in. cut and 0.040 in. feed. Krupp V 2 A stainless steel, about 18 per cent chromium and 8 per cent nickel, can be cut at 115 ft. per min., 0.20 in. cut, and

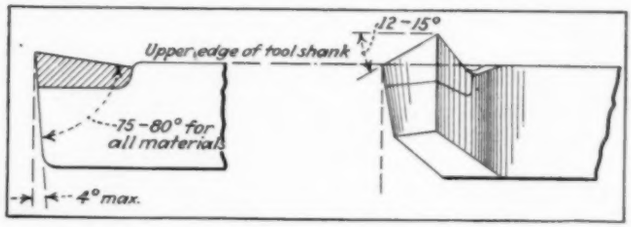


Fig. 4 — Recommended tool angles for planing or shaping. It is necessary to lift the tool from the work on the return stroke to prevent chipping the cutting edge

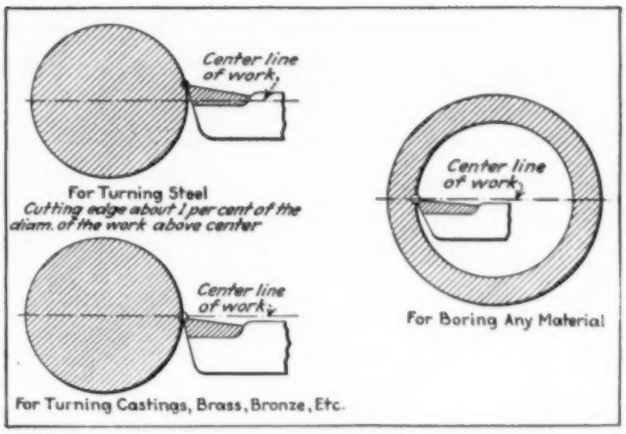

Center line of work
For Turning Steel
Cutting edge about 1 per cent of the diam. of the work above center
Center line of work
For Turning Castings, Brass, Bronze, Etc.
Center line of work
For Boring Any Material

Fig. 5 — Proper location of the Widia tool with respect to the center line of the work

0.040 in. feed. Cast iron of 220 Brinell hardness, can be cut at 280 ft. per min., 0.70 in. cut, and 0.40 in. feed. Perhaps most remarkable of all are some figures for 12 per cent manganese steel, which can be cut at 40 ft. per min., 0.2 in. cut, and 0.012 in. feed. In general, however, the principle of light feeds and high speeds should be borne in mind.

It is essential to have plenty of power and to maintain the speed of the machine. Slowing down in the cut, vibration and chattering are conditions to be avoided. The machine should never be stopped with the tool in the cut and the feed on, as there is danger of breaking the Widia tip under these conditions. Widia tools should be held short and firmly, and should be supported as near as possible to the cutting edge, avoiding the tool posts with the sliding radial supports, so common in this country. The tools should be firmly clamped to a solid support whenever possible. Fig. 5 shows the proper location of the tool with respect to the center line of the work.

Widia tools are usually furnished complete, ready for use. The brazing operation requires care, but the operation is not difficult, and where the user fully understands the application of Widia, it is perfectly possible for him to have the brazing done in his own shop, should he so desire. Several important points should be kept in mind. The shank should be of a good grade of high-carbon tool steel, annealed, or nickel steel, annealed. High-speed steel should not be used for shanks. The shank and tip should be carefully ground and cleaned so that the tip lies flat on the shank and makes close contact with its support. Copper should be used for brazing, and the heating should be done in a muffle furnace with a reducing atmosphere at about 2,100 deg. F. It is necessary to protect the Widia from the direct flame, as otherwise there is danger of oxidation and damage to the material at the high temperatures involved. Borax is used as a flux, and after brazing, the tool should be placed in powdered charcoal for slow cooling. *Open torches must not be used in brazing.*

A sharp smooth edge is essential for best results with Widia, and this can only be obtained with special grinding wheels suitable for the purpose. The grinding can be done in about the same time as high-speed steel, provided the special wheels are used, running perfectly true. Grinding can be done wet or dry, but wet grinding is recommended, using a plentiful supply of water directly on the part being ground, to avoid overheating and sudden cooling. A light pressure should always be used.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Belts, Foremen and Paper Work

"MORE bookkeeping, Al. Did you see those new blanks Williams sent around for us to fill out? Doesn't he think we have work enough to do without filling out a lot of printed forms?" It was Ed unburdening his mind on the way home.

"That's right, Ed. It *is* more bookkeeping. But that seems to be more a part of a foreman's job than it used to be."

"But what's it all about? Why bother us with a lot of questions about belts, and belt repairs? Can't Williams find out what they are from the bookkeepers without bothering us?"

"As I see it, Ed, what Williams wants is detailed information. He can get belt-repair cost in a lump sum from the bookkeepers, as you say, but lump-sum information doesn't always tell the whole story.

"You know that Williams has no notion of making our job harder than necessary. But he wants to know just what belts cost, both in replacement and repairs, before he decides on whether it's cheaper to keep on using belts or to throw them out and put in motor drives."

"But why put it on us?"

"Guess we'll have to call it a compliment, Ed, and swallow the new work along with it. It won't last long I'm sure; only until Williams gets the dope he wants."

"But, Al—"

"You might just as well quit 'but-ing,' Ed. Williams wants to know details about costs. Lump sums don't give him the information he wants. He may find it's cheaper to leave belts on the lathes and put motors on the bolt cutters, or the reverse. But the only way he'll find out is to get detailed information. It's up to us to help him, whether we like it or not."

"I'm glad to help Williams out any time, Al, but I *do* hate paper work. And I don't see why the stock clerk or the repair man couldn't keep the records just as well."

"Williams seems to think that we foremen, who are right on the job, can give him the best facts. He wants to know delayed time, cost of repairs to belts, and the cost of new belts. The first two he would get from us, and the last from the stock clerk.

"And there's another thing to remember, Ed. While we are getting this dope for Williams we have a fine chance to learn a few things for ourselves. It won't do us a bit of harm to know what belts cost, and why. If we're ever going to be more than department foremen we've got to know a lot more about things of that sort."

Is Al right in defending Williams' request for facts from the foremen? Or is it part of the cost-keeping job as Ed suggests? And are detailed costs necessary?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Al Orders an Emergency Pump

I HAVE heard it said that the chief duty of an executive is "to break the rules." Rules are designed to cover the ordinary conduct of business, providing the most logical channels for action under normal circumstances. But when an unusual circumstance or emergency arises, then it becomes a matter for executive action—and the measure of the value of that action is the best practical solution in the quickest time—regardless of rules. So, if in Williams' absence, Al "took the bull by the horns" and showed sufficient initiative to meet an emergency in the quickest way possible, I don't think he should be "called down" for it.

In the first place, initiative is too valuable an attribute to warrant condemning it unless it is misdirected—which it was not in this instance. Secondly, it is easy enough to analyze an emergency after it has been met, and calmly decide that another course of procedure would have been best, but emergencies don't require theorizing half as much as they require quick action—which Al supplied.

—W. T. Van Horn.

Spending Money for Oiling Equipment

AL'S belief in lubricating systems will be perfectly all right if he does not forget to figure whether the machine will stay in service long enough to pay for the equipment, or if it does not, whether the system can be used elsewhere without expensive changes.

He should also have in mind whether the life of the machine can be extended sufficiently by the new method to pay. The added safety due to a centralized lubricating system should also be considered. —Fred Erkelenz.

Whistling in the Shop

WHISTLING in the shop cannot be considered an evil, neither is it a benefit. Most of our foremen make it a practice to cut down on what they consider a disorder of this type, although from my point of view, I could not be harsh to an employee who is carrying on this practice in an orderly manner. In some cases our factory departments are similar to an office, and in order to carry on the work it is best that quiet be observed. As a general rule those who do the most whistling and high pitched singing are the disorderly ones, and in such cases it is proper for the foreman of the department to call them down, but as far as tying the employees down with hard and fast rules, it will work against the welfare of the factory to do so. If the employees whistle and sing in a low and orderly manner I can see no harm in it, for it is a sign that they are contented with their work, and contentment in a shop means higher and better production.

—Fred Aug. Schmidt, *Industrial Engineer.*

THE · NEXT · TOPIC

Should We Buy Tools by the Pound?

ADVANCE QUESTION

Ed feels that no cutting tools can be worth five-hundred dollars a pound. Al contends that the first cost does not matter—that only results count. How do you feel about it?

The Exit Interview

WE USE an employment manager with lots of authority, but it does not include the exit interview. We have no need of such, for before a man is discharged the foreman talks it over at the round table, at which the employment manager sits in. We have found that labor turnover is costly, especially in a small town such as ours. Replacing some types of skilled labor calls for importing and trying out to fit the job. It has happened that when a man provoked his foreman, or the foreman just didn't like the man, or the man's work was not suitable, by talking it over with the other executives, including the E.M., we have been able to shift the employee.

This plan allows the foreman to feel that he runs his department, and that after a man is fired some other executives will not send him back.

The big point, of course, is to consider the saving of labor turnover. It costs a large sum even to change unskilled hands. We have learned that an employee familiar with the shop routine and safety rules is worth more than a green hand will be for many months.

—Charles H. Willey, *Ass't Plant Sup't.*

Gang Bonus in the Shop

IT IS human nature to fear the unknown, and all arguments fall on unresponsive ears when the men hear comments that the gang bonus method means a reduction in average piecework earnings. Operators will have to be taught that there is a difference between reduced costs and reduced wages.

If I understand the plan, it eliminates the old piece price, and establishes groups in which everyone has an individual hourly rate, to be increased by a premium. This hourly rate is set by assuming that the job was put

on a straight day-work basis. Piecework hourly averages are also considered.

Gang bonus is just another method of paying for work done in a quicker, or more efficient, way. It is a big step towards broadening the individual, by showing him what the other fellow does and why. —J. EDWARD DONOVAN.

IN A PLANT employing 600 men, one department of 60 men was placed on a bonus system and the remaining 540 on an individual rate plan. After a 6 months' trial a summary was taken which disclosed the following facts: About 90 per cent of the bonus or premium trouble originated in the bonus department, there being divers causes for this. Very few operators were satisfied with the amount of work accomplished by their fellow-workers. The workman could not, at any time, determine if they were making bonus or not, and this uncertainty was reflected in their efforts which were noticeably decreased. The usual question was, "Why should I exert myself when I don't know what I am working for?" Some men were not able to compute their earnings, so if they did not receive as much pay as they haphazardly figured they should, they would create general dissatisfaction among the other workmen.

—JOHN HUBER, *Chief Time Study Eng'r.*

Preventing Spoiled Work

EVERY foreman and superintendent is doing everything possible to eliminate spoiled work, and still get good production volume. Speed usually acts counter to quality, and so each shop must decide how much of each is best suited to their case. The class of help employed, the method of wage payment used, and the condition of the machinery and tools, all have a bearing on what goes to the scrap pile.

At a foremen's meeting, not long ago, the discussion led around to the quality of some parts then being made. Several views were given as to a standard of quality, and I added mine, which was to get the job by the inspector. This caused a storm of protest but in the discussion that followed it was admitted that the inspectors were there to maintain quality. —L. F. SWANSON.

IN A SMALL contract shop the following incident occurred recently. When properly analyzed it tends to show the increasing number of qualities a good foreman must possess.

One of the men, who had risen from the apprentice class, and was now able to handle his own work to a certain extent, was performing a milling operation on a quantity of slides. The cutting of a narrow slot with an end mill was proving rather difficult. Before he could locate his trouble he had spoiled many pieces, making the same mistake each time. Afraid to tell his foreman, he "junked" the parts, claiming they were lost.

Such an occurrence seems to me to be proof of mismanagement and poor foremanship. The only count that can be held against the workman is that he was untrustworthy.

Being responsible for the early training of this man, the foreman evidently failed to create an atmosphere of trust in his dealings with him. Without the example of an honest, trustworthy leader, no gang is going straight.

—JAMES A. KIRK.

The Foremen's Ideas of Pensions

HAVING made a man-to-man canvass of my department, with a view to obtaining opinions on the pension system, I find a 100 per cent "aye" vote and no dissenting voice. So strongly are the rank and file in favor of pensions that they are even willing to allow the management to formulate the rules governing such a system. This may sound sarcastic, but it is not so intended. On almost any matter of policy the workmen are willing, and even anxious, to state how they would do it, but in this case the question at once struck them as being of such importance as to overshadow even such apparently important questions as age and amount of pension. —L. B. JONES, *Foreman.*

PENSIONING employees is something that all the larger concerns are gradually coming to, but, there is always the probability of the employee leaving the concern after several years when he has accumulated a few hundred dollars in his fund. One method, in which a concern has solved the problem, works in the following manner:

Four per cent is deducted from the employee's wages each week and set aside toward his pension fund. The concern pays the employee four per cent a year on the money deducted, which is also added to his fund. Another feature of the pension fund is the advantage of a forced saving, whereas if he were to deposit his money in the bank, he would be tempted not to make the deposit in times of stress.

To overcome the threat that the employee may leave in order to get his pension money, the concern has adopted the plan of loaning him eighty per cent of his fund, at six per cent interest. The loan must be repaid before he is eligible to a pension. —MORTON SCHWAM.

Shall a Man Sit Down to Work?

THE executives of our company returned from a visit to the Ford plant and ordered the superintendent to take the chairs away from the workmen. The chairs were removed and one or two machines raised to suit the new position of the operator. This change did not increase production, in fact, production fell off and complaints were made by the workmen, and gradually some of the chairs were returned.

Our factory is operated on the Bedeaux point system, time studies having been taken during which the rate of motion was observed and the effectiveness was judged. The normal time is figured and a rest factor added which depends on the energy and fatigue of the job. We have operations that require the use of the hands and the body, and with the operator seated a lower rest factor is used. This means less time for the job when the operator is seated than when standing.

My work is about equally divided between the shop and the office and from my knowledge of the business I feel that we have short cycle jobs that require a delicate touch and can be handled best in a sitting position, while on other work the operator shifts from one place to another and has no time to sit down. If the work is such that it can be done equally fast sitting or standing, why take the chair away and cause bad feeling among the workmen while getting no gain in production?

—CHAS. E. WOOD.

Precision Cylindrical Grinding

By R. E. W. Harrison

Engineering Director, Cincinnati Grinders Incorporated

WHILE it has never been intended that the precision grinding machine should compete with, say, the lathe or the milling machine as a high-capacity metal-removing tool, much has been done during the past few years in improving its efficiency in that respect. It will, however, be readily appreciated that at no time can the precision grinding machine, with a maximum metal-removing capacity of 4 cu.in. per min., for which it requires 40 hp., compete with the manufacturing-type lathe or milling machine, which will remove metal at the rate of 100 cu.in. per min., utilizing 50 hp. in the process. In the one case we are able to remove 1 cu.in. per min. with 10 hp. and in the other, 20 cu.in. per min. with the same amount of power.

Despite the fact that the metal-removal capacity of modern precision grinding machines is so low compared with that of other types of machine tools, there is, nevertheless, distinct evidence that insufficient attention has been given to this aspect of the matter by all concerned, having regard to the fact that the rate of metal removal and the rigidity and mechanical refinements of the machine are the most important factors in arriving at the rate of production which the machine is capable of attaining.

With a modern precision cylindrical grinder of either the centerless or the controlled center type, the following rates of metal removal can be accomplished in a commercially practical manner:

Horsepower Applied to the Grinding-Wheel Spindle	Metal-removing Capacity, Cu.In. per Min., Cast Iron or Steel
5	½
10	1
15	1½
20	2
25	2½
30	3
35	3½
40	4

It will always be found that when work is held between centers on a controlled center-type machine, the grinding wheel cannot be put to work immediately with full power, because of the fact that the centers are almost invariably out of true with the periphery of the work. Owing to the comparatively flimsy support given to the work, time is therefore lost before the wheel gets to operating properly, and then, in the closing phases of the operation, the "sparking out" or "rounding up" period is prolonged, because of the spring in the work which has to be gradually eliminated. Other factors that influence the length of time for the closing phases of the operation are the finish and the limits of inaccuracy demanded. The higher the finish and the more restricted the limits of inaccuracy, the longer the time consumed in the closing phases of the cycle. These closing phases in turn are directly proportional to the rigidity and stability of the machine employed.

Abstract of a paper presented at a meeting of the local machine shop practice division of the A.S.M.E., Chicago, March 18, in conjunction with the Western Society of Engineers.

With a centerless-type machine, the wide-wheel principle of grinding is employed and the thrust of the grinding wheel is counteracted by means of a regulating wheel of similar width. Operating under these conditions it is easily possible to subject the work to the full horsepower available, since the work is trapped between the two wheels and the thrust of the cut is taken on a rigid work-supporting blade. This results in a 30 per cent improvement in the rate of metal removal, with a proportionate reduction in the time consumed. In the opening phases, the rounding up of the work is accomplished in approximately one-half the time, due to the fact that the grinding wheel operates on a diametrical rather than a radial dimension, the rounding up being an averaging process, removing only the amount of metal necessary to establish a true axis of rotation. The time required for the closing phases of the work cycle also is reduced on account of the fact that the work is held more rigidly, being supported throughout its length, and the sizing control is operated at an infinitely greater leverage and with infinitely greater rigidity than that obtainable in the first case.

Three Factors in Production Estimates

Summarizing the foregoing remarks it will be seen that the three main factors to be taken into account when estimating the production possibilities of precision cylindrical grinding machines on a metal-removal-capacity basis are:

1. Opening phases of work cycle. Inaccuracy in the previously machined work, such as lack of roundness and parallelism.
2. Period of maximum rate of metal removal. The maximum horsepower that can be applied to the piece of work being ground before the limited durability of wheel, etc., is reached.
3. Closing phases of work cycle. The rigidity and stability of the machine on which the work is attempted.

The grinding wheels available today, as compared with those available a few years ago, cut faster, generate less heat, have a very much higher ratio of metal removal to wheel wear, and have a higher degree of consistency, i.e., the spacing of the abrasive element is more uniform; hence much has been done to insure the satisfactory performance of the wheels. Straight infeed grinding, otherwise known as plunge cutting or broad cutting, is now carried out along entirely successful commercial lines on work up to 15 in. in width. However, it should be fully recognized that a high and consistent rate of accurate and well-finished production from any precision grinding machine is the result of the combination of a correct grinding wheel with a mechanically sound machine tool.

The practical application of specially bonded wheels running at a peripheral speed of 9,000 ft. per min. (as compared with the 6,000 ft. previously used) to foundry practice is being felt in the form of the expressed desire to have the advantages of this type of wheel applied to the precision grinding machine. However, this practice

has not yet passed the experimental stage, and considerable additional research work will be necessary before the high-speed wheel with its attendant higher metal-removal capacity can be applied to the precision grinding machine satisfactorily.

Careful analysis of a wide variety of work ground on the controlled center-type machine indicates clearly the advantage of the plunge-cut or straight infeed method of grinding, but before the fullest benefits can be obtained from this method of operation, certain essential characteristics in the work should be taken care of. Standard practice when employing a wide grinding wheel is to reciprocate the grinding-wheel spindle mechanically from $\frac{1}{16}$ to $\frac{3}{16}$ in., the extent of this reciprocation being dependent upon the coarseness of the wheel employed and the demands in respect to finish. However, all results observed indicate that a more efficient work cycle is obtained from the use of the broad wheel and the straight infeed method wherever the specifications of the finished work are such that this method can be applied. Generally speaking, work must be turned more uniformly as regards parallelism than when the transverse method of grinding is employed, as localized wear on the grinding wheel entails a comparatively lengthy wheel-truing operation with consequent loss of production.

Small Work Likely to Spring

On work less than 4 in. in diameter by two to three diameters in length, there is invariably a danger, when the grinding is forced, of developing a barrel-shaped piece of work due to springing. This condition is eliminated automatically on the centerless-type machine, where the work is supported in the line of lateral thrust of the grinding wheel by the regulating wheel, and the downward thrust of the grinding wheel is opposed by the support blade. The only way of counteracting this tendency to produce barrel-shaped work on the controlled center-type machine is by efficient steady-resting. However this method of grinding can never be as efficient as the centerless method, as the time consumed in all three of the major phases of the work cycle is greater. In addition, it is seldom that the handling facilities for getting work into and out of the machine are as good as those that exist or can be provided on the centerless type.

The question has been frequently asked: How much time is gained by using the plunge-cut or straight infeed method of cylindrical grinding as against the traversing method of grinding, assuming a common piece of work and identical conditions? If the piece in question has sufficient axial stiffness to withstand the thrust of a wide grinding wheel, it is safe to assume that the time for infeeding will be but one-half to one-fourth, or in extreme cases, even one-sixth of that which is required for traversing. However, it will be realized that no hard and fast rule can be laid down, and each particular piece of work must be considered on its individual merits. As a matter of general guidance, though, it is always better to straight-infeed with a wide wheel than to traverse-grind.

There are a few special classes of work where the high productive capacity of the modified plunge-cut-type machine can be taken advantage of. This machine, while employing a wide grinding wheel, subjects the work to considerably less pressure than is the case when a wheel the full width of the work is employed and oscillated $\frac{1}{16}$ to $\frac{1}{8}$ in. This type of machine is equipped with a grinding wheel 6 or 8 in. wide, and is intended for work up to about 10 in. in length, such as pistons, thin-walled tubes, and other structures of a similar specification.

If a tubular piece of work is subjected to wheel pressure in excess of the inherent stiffness of the wall, a distortion will take place. To insure, therefore, that production is maintained, it is necessary that the work be subjected to a light cut, but that the number of cuts be multiplied, so that a good average rate of metal removal is maintained. This is accomplished on a machine equipped with an automatic hydraulic reciprocation of the work table having a work-traversing speed up to 24 ft. per min. This development in the art of precision grinding is only applicable to a limited number of types of work, and therefore, cannot be quoted as typical plunge-cutting.

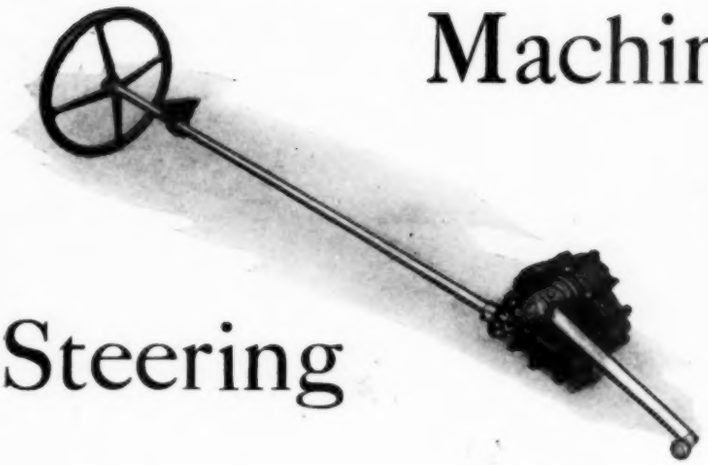
Reviewing the process of evolution through which the art of precision cylindrical grinding has passed during the last seven or eight years, it can be said that as the mechanical features of the machines and the wheels employed on them have been improved in efficiency, it has been realized that production is dependent upon the horsepower capacity of the tool, consequently the structure of the tool has been strengthened and improved, until today these tools are offered to users largely on their power rating. Work that was regularly handled on 5-hp. machines in 1920 and 1921, is being produced today in a proportionately reduced time on 15- and occasionally on 20-hp. machines.

There is still considerable work to be done, both by builders and users of grinding machines, in the direction of the further elimination of idle or non-grinding time between the work cycles. The installation of a conveyor system to save operator fatigue rather than the employment of a higher rate of feed and speed on the machine is often desirable. It is, in the author's opinion, the last evidence of utter futility to provide an operator with a highly efficient and productive machine tool and then to employ his time in wrestling with some heavy, cumbersome piece, which should be handled by a hand crane or fed to the machine on a conveyor.

It will be appreciated that the centerless method of grinding constitutes a generative process, and as such it possesses many advantages over the alternative methods available in which the accuracy of the work is copied or reproduced from some portion of the machine, such as the work-head spindle. Unfortunately, there are many machining operations, such as traverse grinding, which cannot be handled by a generative process. However, it is axiomatic that wherever the generative method can be employed, it produces work of superior accuracy.

New Coolant for Motors

CONTROLLING the temperatures on internal combustion engines has long been a problem both as to lubrication and efficiency. One of the advantages of the air-cooled motor has been the higher temperature at which it can operate. Recent reports from the Army Air Corps tell of a new cooling liquid that can be used in place of water in water-cooled engines. Tested on a standard motor it was found that $4\frac{1}{2}$ gal. of the new chemical cooler did the work of 18 gal. of water, and that it permitted a motor temperature of 300 deg. F. instead of 180 deg., as has been common practice with water. This coolant weighed 84 lb. less than the water required and also permitted a saving on nearly 40 lb. in the weight of the radiator on the plane tested.



Machining Parts for the *Lancia* Steering Gear

By J. A. Lucas

Every precaution is taken in machining to insure the reliability of this important mechanism

TWO malleable-iron castings, of the same pattern, form the box of the steering unit used in the Lancia busses. The shape of these castings make it difficult to hold them while machining, and to overcome this they are designed with four lugs that form a rectangle. These lugs allow the parts to be registered accurately, and represent good practice. In this connection it may be recalled that the opinion is held by some designers that the cycle of manufacturing will eventually return to single-purpose machines, and that universal registration bosses or lugs will be attached to castings having more than one operation, so that they may be registered in any machine accurately and quickly. If this practice were followed there would be no need of separate holding fixtures, and drill jigs would merely be a plate to preserve alignment of the drills.

It will be noted that the design of the holding fixtures for milling, drilling and boring, in the present instance, are simpler than if they conformed to, and registered from, the casting proper. After the castings have been machined to a point where the lugs are unnecessary, they are removed.

After the mating surface is machined the casting is drilled on a multiple spindle drill, registering from two of the four lugs and centering by a V-clamp at the apex.

In designing drill jigs it is the practice of the Lancia company to use substantial button-head bushings, instead of the flush ones favored by some. The drill jig shown in Fig. 2 has a substantial workmanlike appearance, which statement is true of all their fixtures.

The ball bearings for the sector shaft do not seat in the casting proper, but in shallow steel cups which fit tightly in the casting and around the shaft and prevent grease from coming out or dust from getting in. One of these cups is adjustable so as to take up any lost motion. The operation is shown in Fig. 3 and the cups and details in Fig. 8.

The next operation is to bore the bearings for the worm shaft, registering from the openings for the sector shaft. After which they are placed in the future shown in Fig. 4 and again registered from the sector shaft opening, and the seats, for the worm shaft thrust bearings are milled. The solid bearings previously bored, act as bearings for the cutter arbor, which is also guided in relation to the sector shaft opening by open top bearings on the fixture. A dental clutch allows the cutter arbor to be placed and removed quickly. This arrangement insures the proper pitch distances between the worm and sector, the lugs are used for both registering and clamping in this operation. Meanwhile, the worm and worm sector, are coming through the shop on other machines.

Nickel steel is used for the worm sector forging. It is made circular and machined all over. After this it goes to the plating department and is given a coating of copper sufficiently heavy to act as a preventive against carbonizing in the subsequent casehardening operations. It is then fastened to a spider on a gear hobbing machine and the teeth are cut. Before leaving the department the heavy section is cut through at four places as shown in Fig. 5. The fixture swivels on its base to permit this. The object of this preliminary parting is to avoid cutting through a hardened surface later on. Inci-

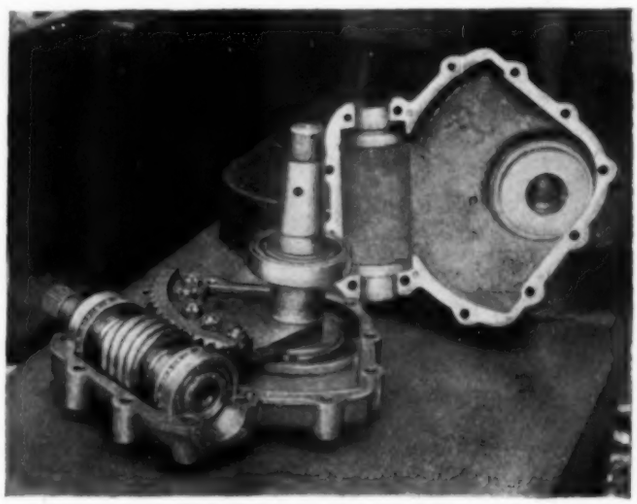


Fig. 1—The ball bearings for the sector shaft are inclosed in steel cups that act as grease and dust guards. One of them is fixed, the other adjustable

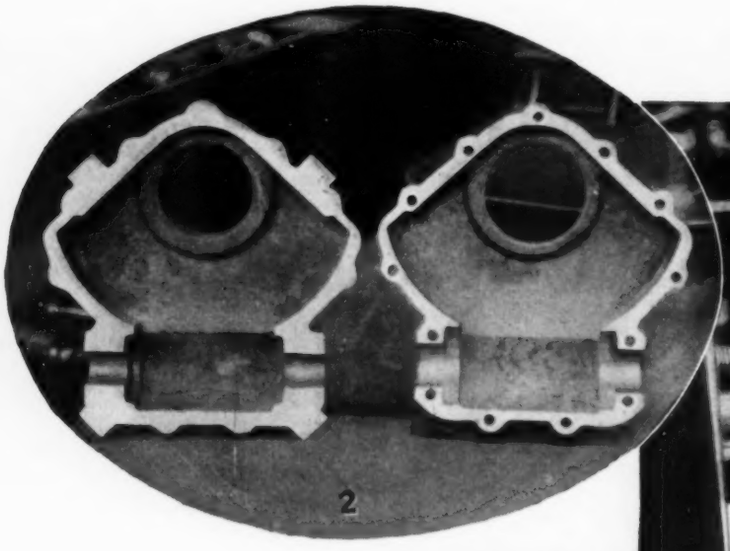


Fig. 2 — The castings have four lugs that are used for registering and clamping purposes. These are removed later, as shown at the right

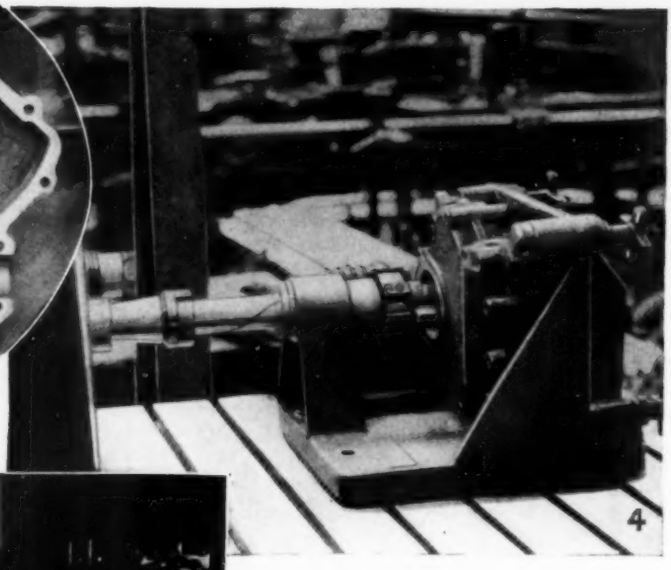


Fig. 4—Boring and reaming the aperture for the sector shaft bearing cups

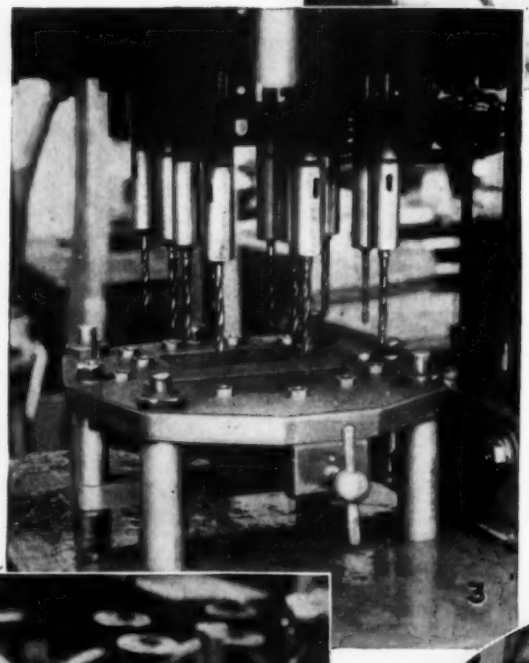
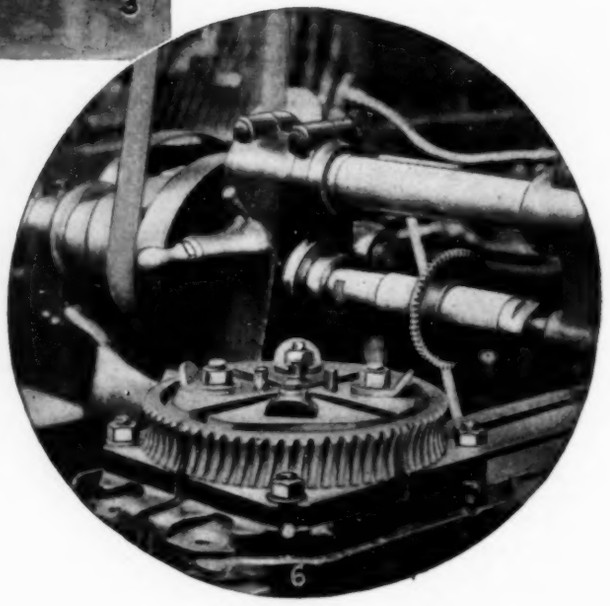
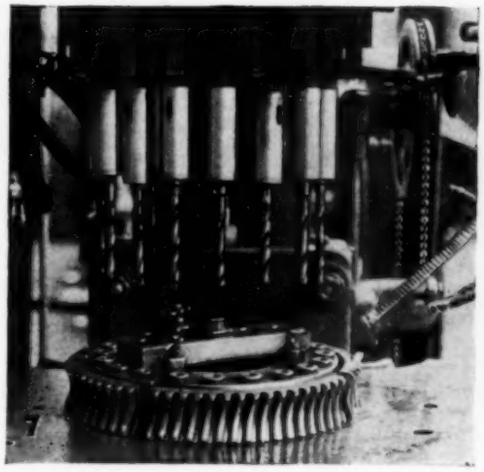


Fig. 3—A sturdy drill fixture which registers from two of the lugs and centers from the V-block at the apex of the casting

Fig. 6—Cutting through the rim section of the multiple sector forging before case hardening

Fig. 5—Using two castings as bearings for an internal milling operation





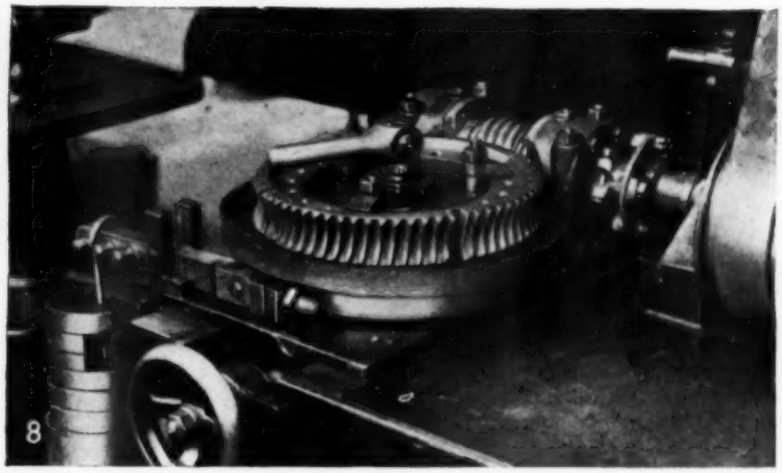


Fig. 7 — Drilling the web of four sectors. The fixture registers from one of the slots, and is centered by three ground pins. Fig. 8 — Rig for grinding and lapping the worm and sector. It reverses automatically the brake being operative in either direction

dentally it takes care of expansion during the heat-treating operation.

The bolts which hold the worm sector to the palm of the sector shaft are body bound in reamed holes. The drilling is done in the jig shown in Fig. 6, and the two parts are afterward reamed together. Another item of interest to any one who has tried to lift a heavy load with a chain hoist when their hands or the hoist chain was wet, is the chain shown on the wheel for raising and lowering the head of this drill press. It is a ball chain similar to those used on electric light sockets except that the balls are an inch or more in diameter. This should be more efficient as a hand chain than the link type.

The lapping fixture, shown in Fig. 7, is an efficient rig for the purpose. The clamping is done in two motions, turning the dogs, and lifting the handle. It can be made to reverse automatically at stated periods so that both sides of the teeth are lapped. The brake can be weighted to suit and is operative in both directions. The slide can be moved in and out to vary the contact.

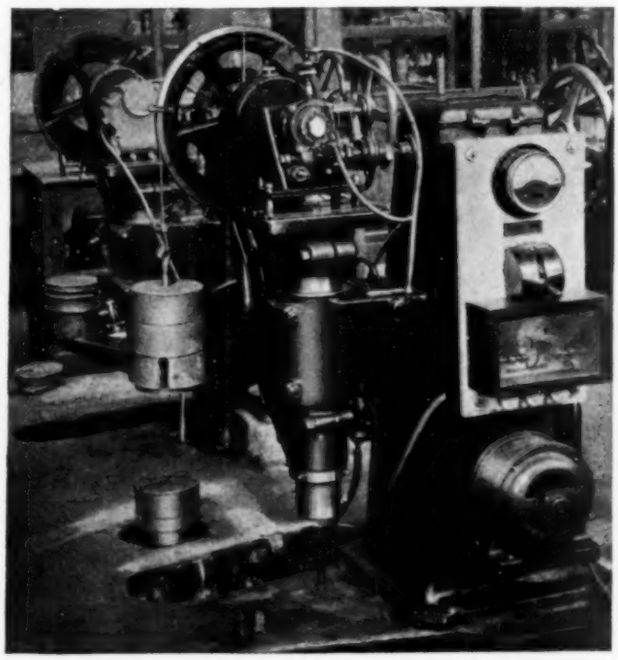


Fig. 9 — Dynamometer used for final "running in" of the assembled unit. This continues until any high spots on the contact part of the teeth are smoothed down

After the final lapping operation the sector and worm are assembled in the box with their bearings, as shown in Fig. 8, and they are then attached to a dynamometer and run under conditions approaching the actual as nearly as possible. Oil is circulated through them, both to lubricate and to cool. A reversible motor, controlled by a relay transmits motion for the full range of the sector in one direction, and then reverses. A loaded brake imposes a load equal to that of a fully loaded bus. A clutch makes it possible to disconnect both motor and brake, and to test by hand. This dynamometer, shown at Fig. 9, was designed and built in the company's shops.

After the gears have been run for about an hour, and have met the requirements of the test, they are disassembled, and both worm and sector inspected for high spots. These, if found, are worked down with a slip stone. For standard automobile work the dynamometer "running in," and the subsequent stoning may seem unnecessary refinements, but it is believed to be necessary with a heavy bus where a smooth working steering gear is required.

Preventing Fire Loss in Enameling Ovens

HANDLING paint and lacquers in large quantities, as is necessary in large, modern automobile plants and other industries where dip tanks are used, involves a fire hazard that is being recognized and dealt with in true engineering fashion. Dip tanks, straining tanks and drain boards are now piped for quick discharge into a large storage tank.

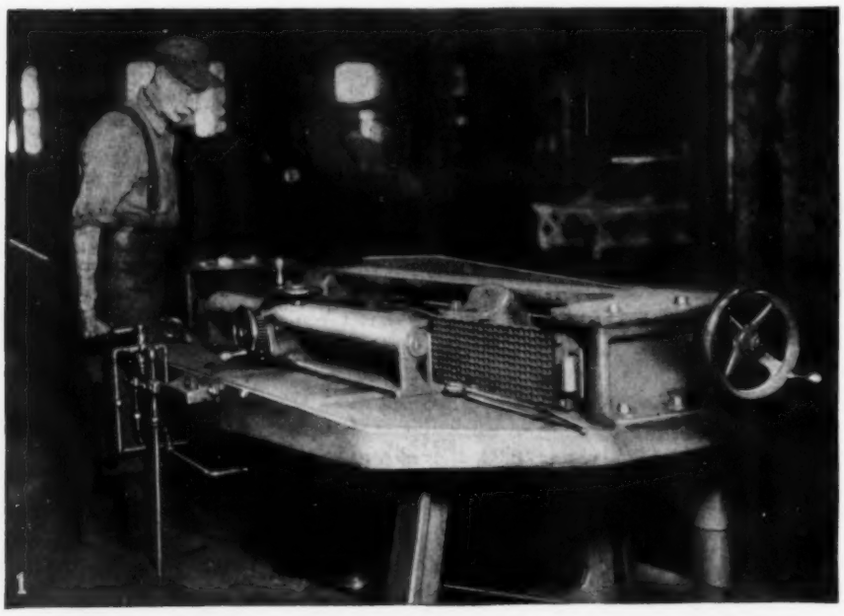
To insure action at all times, whether the plant is in use or not, the quick-opening valves used are held shut by fusible links that open automatically when the heat gets near the danger point. In addition Foamite is automatically applied in the same way.

Locomotive Spring Construction

Operations performed in building semi-elliptic springs in a Canadian repair shop

MATERIAL required for making locomotive springs of the semi-elliptic type, as constructed at the Stratford, Ont., shops of the Canadian National Railways, is cut off to length and then arranged in sets to suit the type of spring assembly required. A spring steel of English make is used and the leaves vary from 3 to 5 in. in width, as many as 28 pieces being required to build up a complete spring. The process of manufacturing includes handling in sets in order to insure uniformity.

After shearing and piling, the leaves are heated to approximately 1,550 deg. F. and nibbed in a punch press equipped with an adjustable die to accommodate the different lengths encountered. The leaf is centered by end plates operated by a quick-acting equalizing screw, and the central section of the leaf rests on the die block. The operation forms a spherical projection that fits into the impression of the adjoining spring, thus providing a means of alignment.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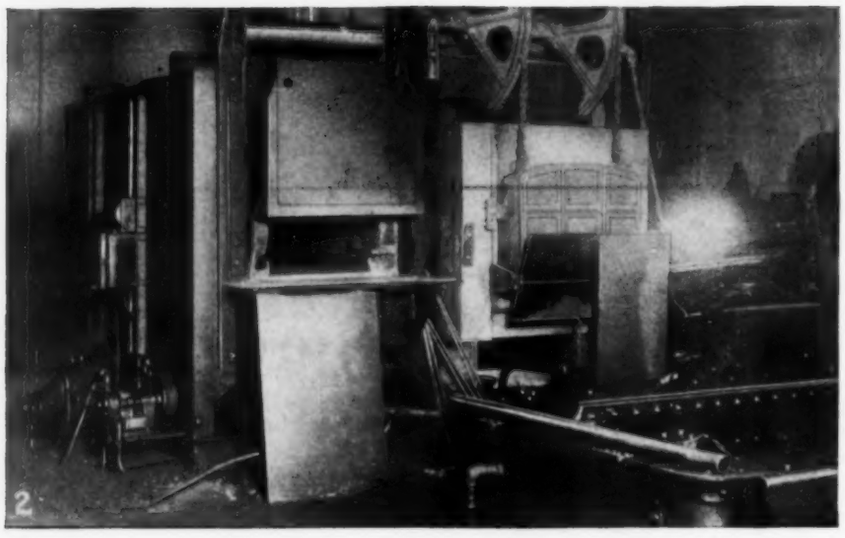
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The leaves of the spring are bent hot, and afterwards tempered, as shown in the above views

Spring sets then are reheated to 1,650 deg. F. and formed in the spring bending machine illustrated in Fig. 1. The first leaf is formed over a master block to the proper contour, then the second spring leaf is formed over the first leaf, the second leaf being used to form the third leaf, and so on until the entire set has been completed. Tempering follows forming, the two electrically operated furnaces shown in Fig. 2 being used to heat the sets at 1,500 deg. F. Quenching is done in oil by immersing the leaves in the tank shown in the foreground. Another view of the tank is illustrated in Fig. 3, which also shows the tank used for cleaning in an alkali solution. The work is transported in a mesh basket by an overhead electric hoist as shown. After being dried the leaves are drawn in a salt bath at a temperature of 800 deg. F., the drawing unit being shown at the rear of the illustration.

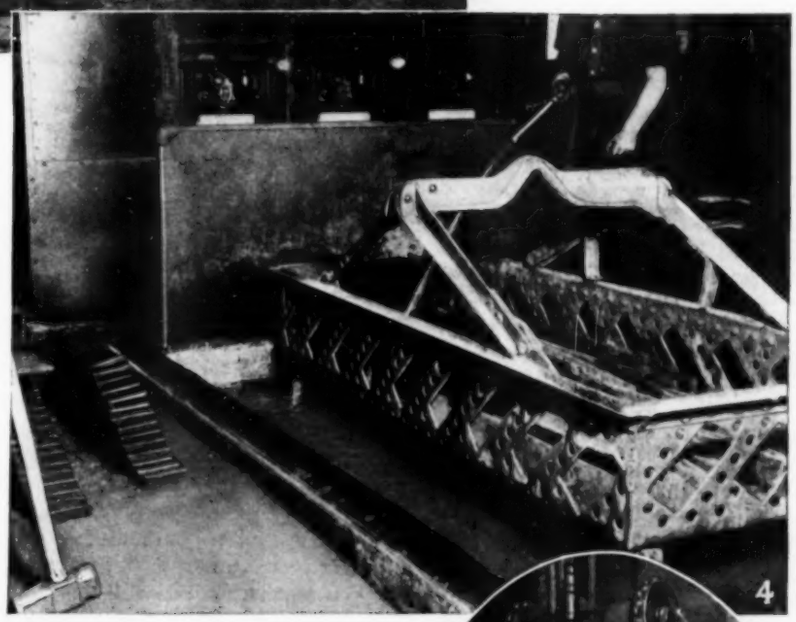
Next the leaves are washed by placing the loaded basket in a concrete pit and applying water as shown in Fig. 4. The leaves then are well coated with oil and arranged again in sets and placed on stands ready for banding.

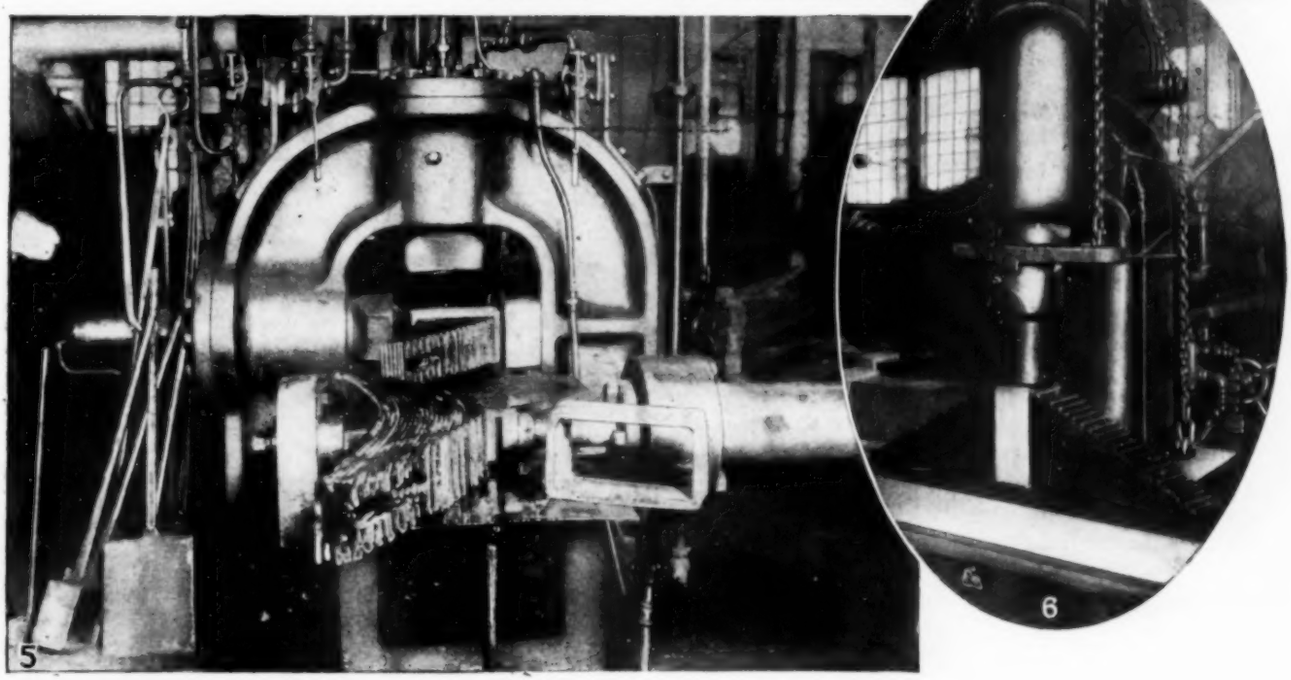
Banding is done in the hydraulic machine illustrated in Fig. 5 in two operations. At the front of the machine the spring set is compressed and the band is assembled in place. The table is made with a drop platform and after the work has been seized by the horizontal hydraulic unit the platform is lowered to give accessibility for passing the band over the

Cleaning and washing operations on the springs are carried on in the metal tanks shown in Figs. 3 and 4. The method of banding by applying a relatively loose band and shrinking it by a two-way hydraulic press is shown in Fig. 5, and Fig. 6 shows the method used to test for tightness of band, and deflection

open end. At the second operation the spring band is compressed and squeezed by a combination horizontal and vertical press.

A test is given each spring assembly in the machine shown in Fig. 6. It is hydraulically operated offering deflection and capacity tests that are checked through pressure gages. Upon passing the requirements of these tests the springs are ready for use.





Tom Johnson Has a Plan to Reduce Unemployment

By John R. Godfrey

"THIS unemployment business is getting my goat, Godfrey," said Old Man Johnson the other day when I went to see him. "Of course I know the country as a whole is busy and that we have trouble getting men, of the right kind. But I also know that our employment man turns away a lot of applicants who need work even worse than we need men, because we can't use them. Talk about square pegs in round holes. Why, Godfrey, it seems to me that its getting harder to find round pegs every year. What is your idea of it?"

As usual I told the Old Man that I could listen a lot better than I could talk, and that I would be glad to know his idea of it all.

"Of course, none of the shops pay the attention to training boys that they used to, Godfrey. We both served four years and you get darn few boys today who will do that, even if we wanted them. Tom says we don't need four-year men except for the repair gang, anyhow. He's got some wild ideas on training, but we may have to come to it. Better give Godfrey an earfull," said the O. M., turning to his son.

"What's the use, Dad? Uncle John knows as well as you do, that you don't need all-around men to run semi-automatics, to load fixtures on a big hydraulic-feed milling machine, and in many other places. And we don't even take the trouble to train men for the kind of jobs we do need them for. Seems easier to pick them out of some other shop and let the other fellow do it."

"But you can't train a bunch of men who never saw a machine without upsetting the production line, Tom. You know that. And we can't afford to run a school for farmers who think they want to be mechanics but who ought to be back on the farm anyhow."

"Now let's try to calm down a bit, Dad, and see just what the situation is. We need men and a lot of men need work—but they are not the kind of men we can use. And they don't seem to fit into any job except as laborers. Electric shop trucks and conveyors have cut the need for laborers, so they are just plumb out of luck.

"As a result we have men who are willing to work but who can't find a job. It's a cinch that they've got to eat and sleep somewhere. So if they eat and sleep without working, some one who works pays for it. They may live by pan-handling or from soup kitchens of the Salvation Army—but we all help pay for it. Doesn't it seem to be reasonable, Dad, that it would be cheaper to train such men enough to earn a living at some of the jobs we have open, than to go on keeping them idle?"

"Sounds all right, Tom, as I've told you before. But how can *we* train them? It's just as much the job of every other shop as it is ours. And if we train them some other shop hires them away as soon as they hear of it."

"Partly true, Dad, but there's a way to prevent that, as I'll try and tell you a little later. First let's talk of the teaching. Do you remember taking me through some of the big shops during the war, Dad? Every one of them had training schools in some part of the shop. They had machines and teachers to show the green men how to handle them. And it was surprising how quickly most of them learned how to run machines well enough to go into the shop.

"I remember one place where they also used the training room as a sort of 'finishing school' for those who knew the job but were a little too slow to keep up with the production line. A few days under the training teacher usually pepped them up so they could hold their own with the rest of the gang."

"I remember that myself, Tom. But that was war time and we all felt patriotic you know. You couldn't put that idea over now."

"Seems to me, Dad, it's just as patriotic to give men who want to work a chance to earn their keep, as anything I know of. Especially when it's a plain open-and-shut proposition of giving them work or keeping them without working. But instead of having each shop run a training school it would be a lot cheaper to have one or two schools in a town of this size and divide up the cost among the shops who benefited by them.

"It's a chance for your Board of Trade to do something worth while, Dad. You can start a training school in any one of several idle buildings here and it won't cost much when the cost is divided up among the shops who can use men of that kind. If each shop pays its share on some pro-rata basis, such as the number of its employees, or the size of its turnover, the total cost will be much less than as though each shop had a school of its own. Then there won't be any object in trying to steal each others' men.

"What's more, Dad, you can tell your Board of Trade bunch that it will cut out most of the pan-handling, and that the chap who won't grab a chance to learn how to make a living can be spotted so we won't waste sympathy on him.

"Of course you can't make machine operators of them all, and we don't want to. Some sort of training could be given to fit for the other industries in town—and so help to sort out men into lines where they fitted best. It isn't going to cure all our troubles, Dad, but I'm sure it will help and I hope you'll try and put it over."

I'm wondering if Tom's scheme isn't worth trying out a little.

Some Observations on Thread Milling—*Erratum*

THE captions for Figs. 3 and 4 of the above article by Prof. N. N. Sawin of the Skoda Works, Pilsen, were in error in stating that the curves were obtained from data presented by Herm. Walter, page 375, (Fig. 3), and W. Haberkorn, page 374, (Fig. 4), of issue of Nov. 8, 1928, of *Maschinenbau*. The curves were obtained by a series of tests at the Skoda Works giving results very close to the data published in *Maschinenbau*. The caption should have read: "Fig. 3—Relation between lead of thread and cutting time; and, Fig. 4—Relation between diameter of work and cutting time.

It was recently suggested that tubular rivets and eyelets were susceptible of simplification. The industry is now circularizing all manufacturers to ascertain whether or not there is a need for simplification in their industry. Replies to date indicate that a reduction in the varieties would be of considerable benefit to all concerned.

Corrosion Resistance of Aluminum Alloys

By Henry S. Rawdon
Metallurgist, U. S. Bureau of Standards

THE fact is now well established that some sheet duralumin, as well as some other high-strength aluminum alloys, under some conditions of use do not maintain their initial properties without impairment. The change may in some cases be very pronounced. This change, as shown by the tensile properties, consists essentially in a marked lowering of the ductility of the material accompanied by a somewhat smaller proportional decrease in the tensile strength. Unlike the atmospheric corrosion of iron or steel, the change which may occur in sheet duralumin is not accompanied by any very marked surface indications. In some exceptional cases, sheet material has become so weak and brittle that it could be broken readily with the fingers.

The very extensive and successful use of the light aluminum alloys for aircraft has served in large measure to refute imputations which have been made at times concerning the unreliability and lack of permanence of this class of material. Experience has shown that most sheet duralumin under most conditions retains for years its initial strength and ductility unimpaired. With the increasing demands imposed upon the materials of modern aircraft construction, however, the question of the permanence of such materials becomes one of increasing importance, and it was this aspect of the problem which prompted the study undertaken.

The nature of the structural change whereby the impairment of sheet duralumin is brought about is a form of corrosive attack. The results of the many laboratory corrosion tests which have been made and also the weather-exposure tests support this assumption. There can be very little doubt, indeed, but that this is the true explanation of the phenomenon. The corrosive attack is not of the ordinary familiar type, however. The characteristic feature of this attack is that it is not merely a surface attack but a penetration into the "body" of the metal. The path followed is an intercrystalline one, the corrosion being localized almost entirely along the grain boundaries. For this reason, it is ordinarily referred to as "intercrystalline corrosion."

Duralumin Must Be Aged

In order to develop its highest tensile properties, duralumin must be heat-treated. The method by which the heat-treatment is carried out is very intimately related to the susceptibility of the heat-treated duralumin sheet to embrittlement by intercrystalline attack. The heat-treatment of duralumin consists of two operations, quenching and aging. Heat-treated sheet duralumin for which the quenching has been done in cold water is far more resistant to intercrystalline attack than the same which has been quenched in hot water before aging. Heat-treated material for which the aging process has been accelerated by using an elevated temperature is much less resistant than if the aging is done at room temperature.

Cold-working of sheet duralumin, by stretching, bending, and the like, results in a condition which is somewhat favorable to intercrystalline corrosion, but this feature is a minor factor as compared with the differences in corrosion resistance which may result from improper heat-treatment.

Properly heat-treated sheet duralumin is not necessarily corrosion proof. Corrosion of the ordinary type may be expected to occur; hence the need of protective coatings.

Oxide coatings formed by electrolytic treatment ("anodic process") as well as similar related coatings, afford only very little protection in themselves. They must be kept well greased. The type of grease used is of secondary importance, the frequency of renewal is of prime importance.

Aluminum Powder Prevents Corrosion

Coatings of the spar varnish type are of only slight value. The addition of aluminum powder, however, reduces very greatly the permeability of such coatings by atmospheric moisture and also retards the deleterious effect of light on such coatings. Clear and pigmented varnish coatings as well as bitumastic enamel exposed in various solutions in laboratory corrosion tests failed by blistering. Aluminum-pigmented rubber coatings have given excellent performance in laboratory corrosion tests.

Metallic aluminum coatings produced either by the metal-spraying process or by rolling a duplex slab having a duralumin core and aluminum surfaces into sheet form, thereby producing a coating which forms an integral part of the finished sheet, have given most excellent results. Protection of the "cut" edges of aluminum-coated duralumin sheets appears not to be necessary if the sheet has been properly heat-treated.

In a series of weather-exposure tests of sheet duralumin upon which accelerated corrosion tests in the laboratory by the wet-and-dry corrosion method in a sodium chloride solution had already been carried out, a close parallelism between the results of the two kinds of tests was found to exist. Predictions based upon the results of the laboratory tests were, with but few exceptions, fulfilled in the exposure tests.

It has been shown by these tests that the lack of permanence or embrittlement of sheet duralumin which has been observed in some of this material in service under some conditions is largely, if not entirely, to be ascribed to corrosion. A corrosive attack of an intercrystalline nature is very largely responsible for the degree of embrittlement produced. In the exposure tests, as indicated by the laboratory tests, the rate of embrittlement was greatly accelerated by a marine atmosphere and by a tropical climate.

The exposure tests confirmed the laboratory tests in showing that variations in composition of duralumin which do not result in wide departure from the ordinary "duralumin composition" are of almost negligible importance so far as corrosion behavior is concerned. Of the high-strength aluminum alloys which differ materially in composition from duralumin, the alloy containing copper as the principal alloying element was most susceptible to intercrystalline attack.

Variations in the heat-treatment procedure used for duralumin appear to be major factors in determining the susceptibility of the heat-treated sheet to intercrystalline

Abstract of a paper presented at the annual meeting of the A.I.M.E., held in New York Feb. 18-21, 1929.

corrosive attack during exposure to the weather. The quenching rate, as determined by the use of cold or hot water or oil as quenching media, and the aging treatment (room-temperature aging *vs.* accelerated aging) are the most important factors in this respect. The use of hot water or oil as a quenching medium for sheet duralumin or an accelerated aging treatment is not to be recommended for duralumin that must withstand severe climatic conditions, such as marine and tropical service.

Cold working of properly heat-treated sheet duralumin by stretching or cold rolling does not affect very greatly the susceptibility of the material to embrittlement by intercrystalline attack when exposed to the weather. With improperly heat-treated duralumin this factor is of much more importance. The exposure tests have clearly shown that corrosion of the more familiar or pitting type may occur with duralumin. The effect upon the tensile properties although similar in character is, in most cases, decidedly less than that of the intercrystalline type.

It has been shown that aluminum coatings are, by far, the most dependable. The useful life of clear varnishes is very short, the addition of aluminum "pigment" increases the permanence of the varnish very greatly. On the other hand, the addition of aluminum pigment to rubberlike coatings while decidedly successful in the laboratory, under exposure conditions has not given satisfactory results. Surface oxidation by "anodic" process and similar coatings have no lasting protective value unless well greased, and even when greased they have not proved to be resistant against severe exposure conditions, although with milder exposure conditions fairly satisfactory results have been obtained. Simple grease coatings "reinforced" with aluminum powder have given satisfactory service under mild exposure conditions but not entirely so for severe (marine) conditions.

* * * *

In the discussion that followed Mr. Rawdon's paper, E. H. Dix, Jr., metallurgist for the Aluminum Company of America, pointed out that the effect of the corrosion mentioned was most important where thin duralumin sheets are used for aircraft construction, in which factors of safety are necessarily low and the consequences of failure serious. He differed with the author as to the effect of cold rolling on susceptibility to corrosion. The experience of the Aluminum Company has been that cold working does not impair corrosion resistance, but may improve it.

On the subject of anodic coatings, Mr. Dix said that their principal value lies in their forming of an excellent base for paint. It is questionable whether this effect is caused entirely by the better adherence of the paint or whether the corrosion resistance of the thin film is sufficient to resist the action of any moisture which permeates the paint film and thus prevents the blistering of the paint that sometimes takes place under other conditions.

Referring to Mr. Rawdon's statement concerning the protection of the cut edges of aluminum-coated duralumin sheets, Mr. Dix pointed out that the protection of the cut edges is due to the difference between the solution potential of the pure aluminum used as the surface coating and that of the strong alloy composing the core. The protection even extends to rivet heads of normal alloy used in Alclad sheet.

Extensive accelerated and actual weather tests of the Alclad product, which is the answer of the Aluminum company's research men to the corrosion difficulties of the older alloys, have shown that, when properly heat-treated, Alclad is immune from corrosion. The evidence indicates that intergranular corrosion is an electrolytic attack caused by the difference in solution potential between the material at the grain boundaries and that within the grains. The presence of the pure aluminum on the surface of the Alclad sheet overcomes this action.

Early Electric Cranes

By C. M. Conradson

WITH reference to John R. Godfrey's remarks on page 365, Vol. 70, on traveling cranes, it is probable that he was misinformed as to the genesis of the electric traveling crane. In 1888, when the multi-motored electric crane was designed by Alton J. Shaw, I occupied a desk next to his in the drawing room of the Edw. P. Allis Company of Milwaukee, and was in close touch with all matters relating to the development of this invention.

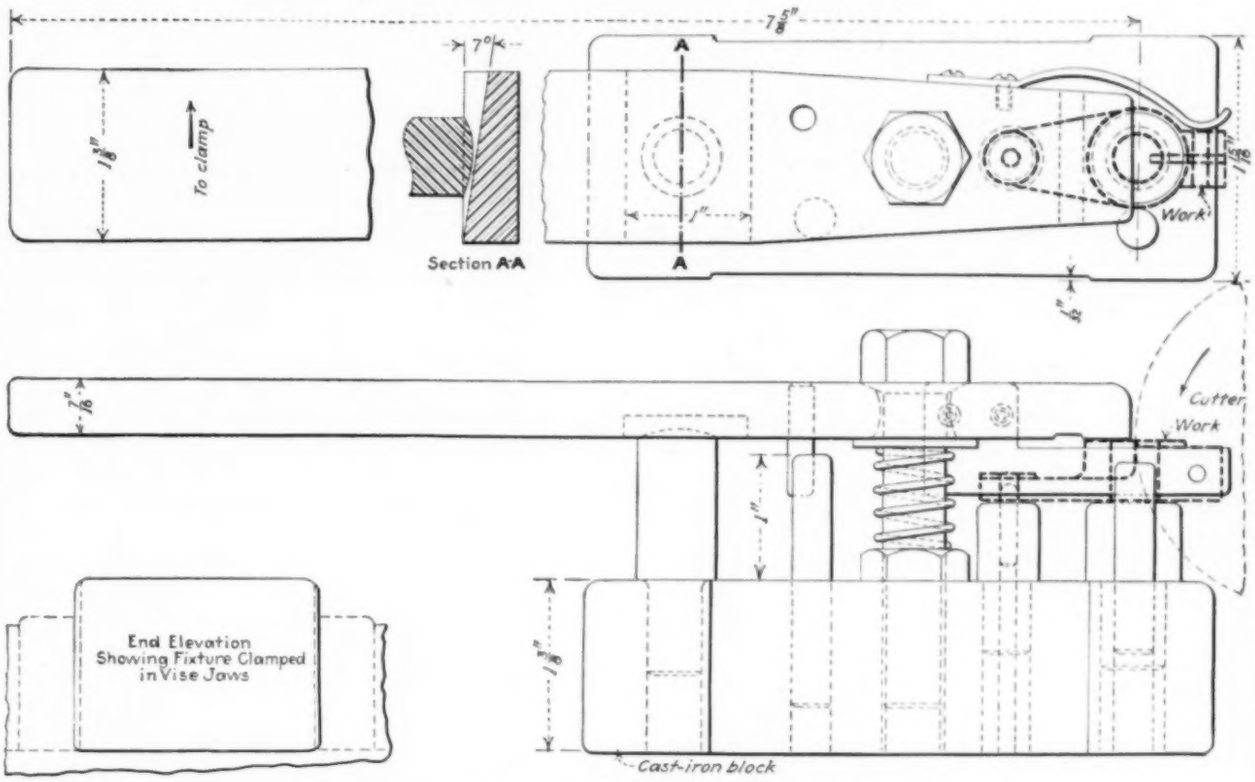
At that time the company was using three traveling cranes, one a 30-ton Morgan crane, square-shaft driven, commanding the erecting shop of what was called the Reliance Works. This crane was a magnificent piece of work, both as to design and workmanship, and stood up nobly under continuous heavy overloads. In the foundry were two 20-ton Yale & Towne cranes driven by what was called the "flying rope" system, greatly favored by Henry R. Towne, the designer. The crane bridge was squared by an ingenious but unreliable rope system. A rope pulley received motion from the flying rope, and the various motions were driven by a complex and intricate train of clutches and square shafts.

Edwin Reynolds, general superintendent, asked me if I would undertake the problem of rebuilding the foundry cranes. I replied that I had had no crane experience and suggested that Mr. Shaw was thoroughly familiar with the Yale & Towne cranes, having worked on their design, when in the employment of the Yale & Towne Company some years before. Mr. Shaw gladly undertook the work, but just at that time was obliged to go to Ft. Howard, Wis. to fix up a boiler furnace of his design. At Ft. Howard, he saw the first electric trolley line in the state and came back full of enthusiasm as to the possibilities of adapting the electric motor to crane service.

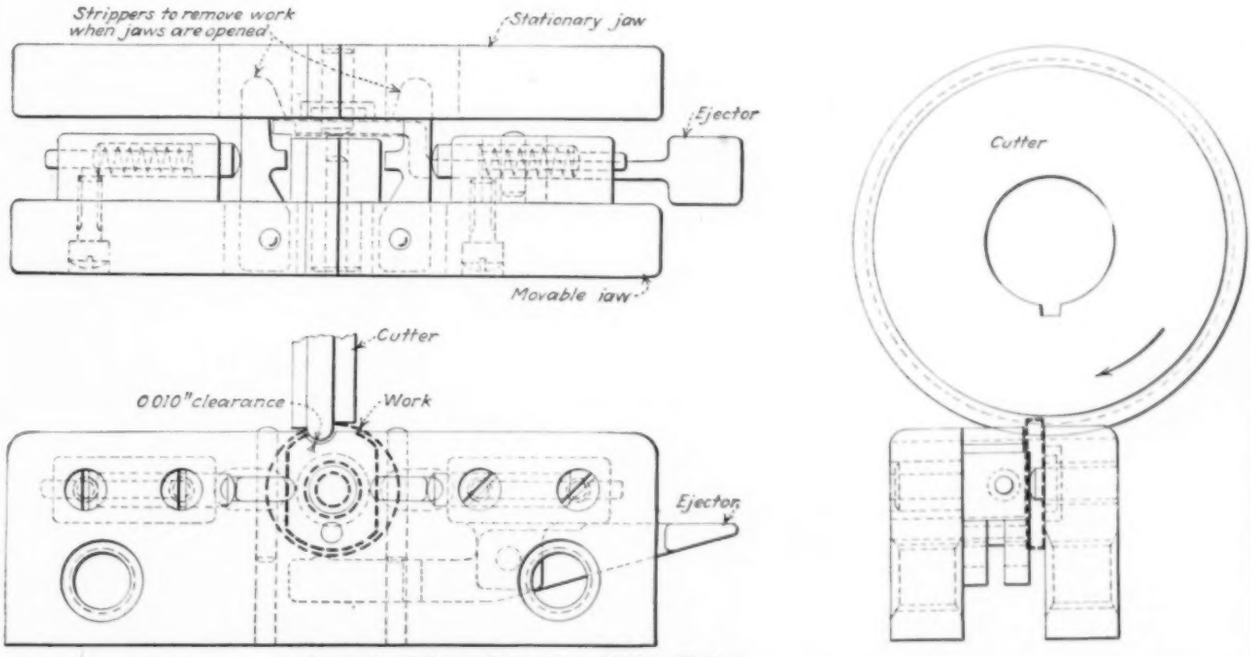
Shaw then designed the first multi-motored electric crane, which was built by the Allis Company, and was a perfect success from the beginning, so much so that Ed Williams, manager of the Williams Engine Works of Beloit, Wis., insisted on having a similar crane. This crane was also built by the Allis Company. This covers the initial development of the electric traveling crane in the United States. Builders may have refused to build multi-motored cranes, but not for long, as three such cranes were exhibited at the Columbian Exposition.

Shaw was not the first builder of electric cranes, however. In 1886, Dr. Clarke Capen of Madison, Wis. traveled in Europe and told me, on his return, that he saw electric jib cranes in use in the Creusot Works in France. These cranes were described in various technical journals at the time. About this time an article appeared in *Engineering* describing an electric traveling crane built in England. The article referred to the fact that, although the multi-motor design was considered, the crane was actually built with one motor, and this was the first electric traveling crane ever built.

Typical Vise Jaws and Vise Fixtures



A Milling Fixture With a Quick-Acting Clamp, and Held in Vise-Jaws



An Efficient Form of Vise-Jaw Milling Fixture

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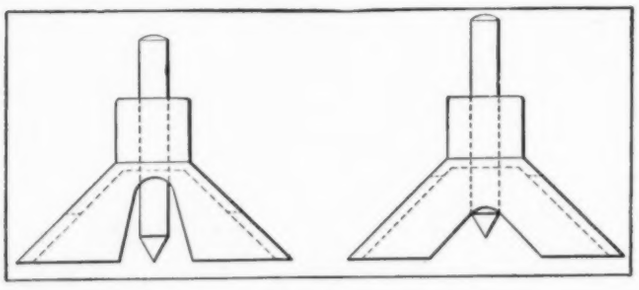
IDEAS · FROM · PRACTICAL · MEN

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit.

Tool for Laying Out Work

By G. C. Martinsen

The sketch shows a small tool that I have found useful in prick-punching the lay-out lines on heavy machine work. The base is conical both inside and outside, and has an opening to permit the workman to see the lines he is to punch. At a right angle to this opening is another one having an included angle of 90 deg., as shown in the view at the right. The 90-deg. opening is used



Tool for prick-punching lines

to support the device on round work while prick-punching the lines for key seats or slots.

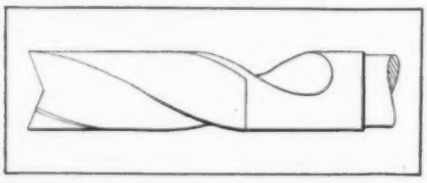
As may be seen, the punch is guided in the upper part of the base, so that it is always at a right angle to the work. By this means, the point of the punch is prevented from pushing out of line when it is struck with the hammer. By placing the base over the end of a piece of round work, the work can be punched for drilling the centers.

Grinding Drills to Prevent Burrs

By C. H. Hays

The sketch illustrates a method of grinding drills to prevent the formation of burrs where the drills break through, when drilling thin material such as sheet-steel, bakelite, etc. Of course, the drills must be guided by bushings.

We are using drills ground in this way for drilling the flanges of transformer tanks; a job that when drills ground in the regular manner were used, took longer to remove the burrs than did the drilling of the holes. Drills so ground act like trepanning tools and produce slugs similar to those produced by punching. The angle ground in the drills is governed by the kind of material to be drilled.



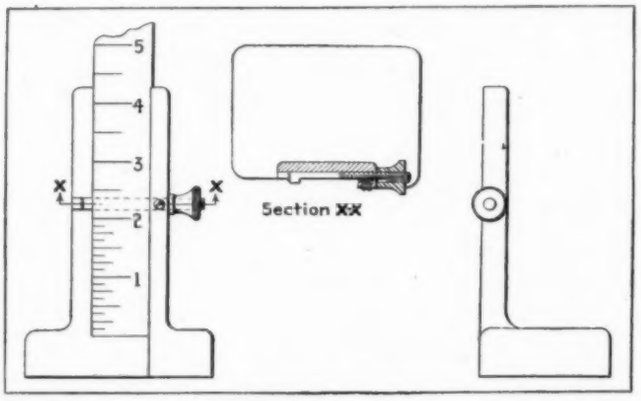
Drill ground to prevent formation of burrs

The transformer tanks drilled by drills ground as shown in the sketch were of 0.032-in. hot-rolled sheet steel and the drills were No. 9, carbon steel. The drills averaged about 190 holes per grind, and the burring operation was entirely eliminated.

A Convenient Scale Holder

By Hubert M. Taylor

In the illustration is shown a convenient scale holder for the machinist who works on the layout plate. The head of a combination-square set is usually used for this purpose, but it has a number of disadvantages. The



Scale Holder for the layout plate

lower half inch or so of the scale is not visible, due to the design of the clamp screw and the support, and the vertical adjusment is not as great as it should be.

To overcome these objections, the scale holder shown in the illustration was made. After machining the base and the front face, the holder was japanned. The thumbnut and the screws were casehardened.

Equalizers for Irregular Work

By W. Hinman

In machining work that is warped or twisted, one part may be clamped in the usual manner, but for the other part, or parts, it is necessary to use one or more equalizers of some sort to avoid undue strains in clamping. While the work may be equalized by means of wedges, they are apt to work loose under the cut and so defeat their purpose.

Equalizers are often made as shown in Fig. 1, the equalizing member being a rocker held on a fulcrum pin.

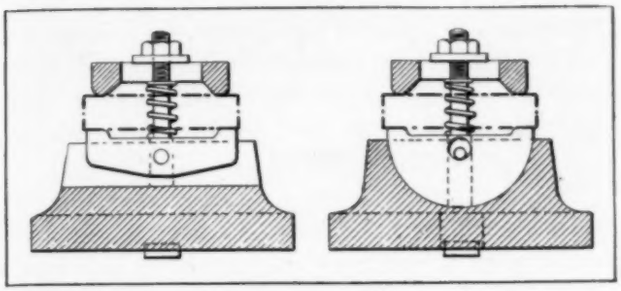


Fig. 1 — Fulcrum-pin equalizer. Fig. 2 — Semicircular equalizer

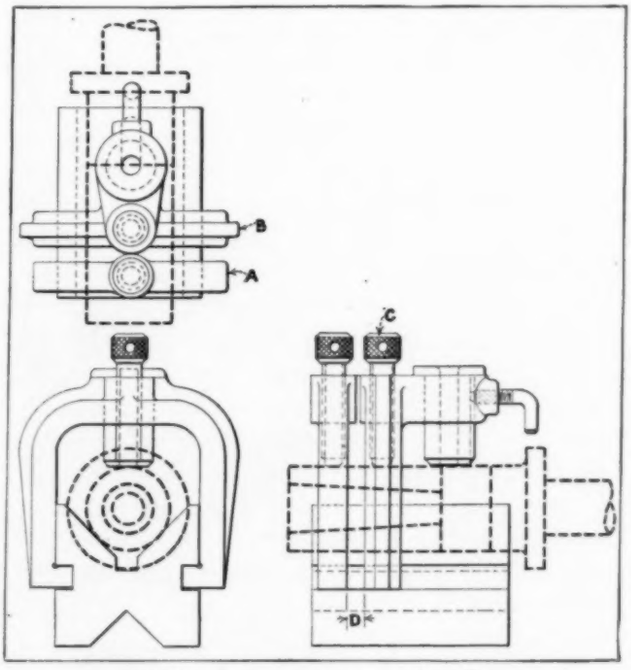
Such a device, however, will not hold the work under a heavy cut, because the friction between the rocker and the fulcrum pin is not great enough to prevent it from twisting.

The semicircular equalizer illustrated in Fig. 2 overcomes this objection, since the clamping pressure creates enough friction between the equalizer and its semicircular seat to prevent the work from twisting under the heaviest cut. The pin through the equalizer is enough smaller than the hole to allow free rocking motion within certain limits. The greater the difference in size between them, the greater will be the limit of motion.

A Drill Jig for Round Work

By A. P. Gwiazdowski

A standard toolmakers' V-block was transformed into a very useful drill jig at the engineering shops of the University of Michigan, as shown in the illustration. The clamp *A* holds the work which is to be drilled for a



V-block converted into a drill jig

drift slot. The holding screw is provided with a copper tip to prevent marring the work. The clamp *B* carries an offset bushing-plate, in which is a slip bushing that can be adjusted up or down, according to the diameter of the work. The bushing is held in place by a threaded rod, bent at the outer end to form a handle.

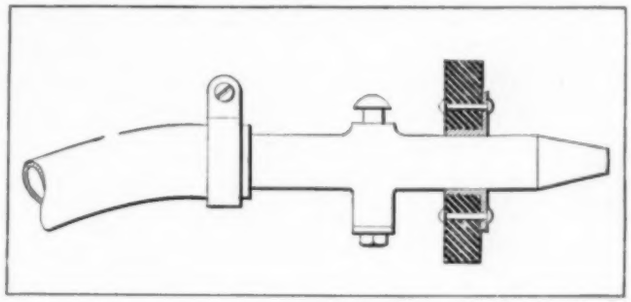
After the first hole has been drilled, the screw *C* is loosened and the clamp is moved to the right an amount equal to the diameter of the drill. Then the next hole is drilled. This procedure is repeated until the last hole has been drilled. The new position of the bushing for each hole can be accurately located by measuring the distance *D* and adding to it the diameter of the drill.

Protecting Air Guns from Injury

By Charles Kugler

In a large plant where I was employed, the air guns were continually being damaged through carelessness on the part of the workmen. The men were on piecework and when they had finished with the guns they would drop them on the concrete floor, in spite of orders to hang them up when they were not being used.

The damage incident to this treatment was prevented



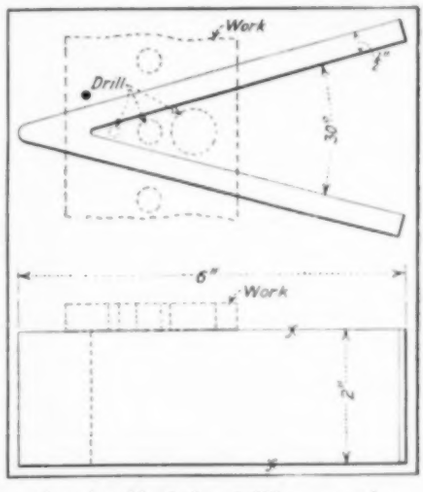
How the air guns were protected

by soldering flanged collars on the bodies of the guns and riveting thick leather washers to the flanges, as shown in the illustration. When the guns are thrown on the floor, the washers act as buffers and prevent injury to them.

A Convenient Angular Block

By C. W. Hinman

The illustration represents a cast-iron angular block that is convenient for use in drilling, reaming, or in light assembling on the bench. Only the top and bottom surfaces need be finished. The size of the block and the angular relation of its sides to each other can be changed to suit the class of work for which it is to be used. Besides drilling and reaming, the block can be used in the bench assembly of small, light parts in such operations as driving through-studs and mandrels. Blocks of this kind are so cheap that they find a wide use.



Angular block for drilling, reaming and light assembly

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

Light Alloys in Machine Construction

ALUMINUM alloys have been used for a long time, but it is only in recent years that we have been able to utilize them successfully to an appreciable extent as load carrying materials. The never ending search for light and strong construction in aircraft has done much to direct attention to this material, and as a result we see aluminum alloys used more and more to replace both wood and steel.

A striking example seen recently was an airplane wing rib formed of thin aluminum sheet, rolled and stamped to special sections and riveted into a modern design of beam for this purpose. The rib was sixty inches long and weighed less than a half ounce. Yet the beam stood a load of eight hundred and fifty pounds before failure. A similar beam one hundred and eight inches long and weighing but seventeen ounces withstood a load of one thousand one hundred pounds with no sign of distortion.

With examples like this it is quite possible that builders of automobiles, and of many other types of machines, may find a solution for some of the problems of weight and stiffness that now confront them. A few machine tool builders now find use for light alloys in rapidly moving parts. Perhaps still further uses may be possible in the near future.

New Wine in Old Bottles

AS HISTORY repeats itself, so do the adages and maxims of one generation frequently apply to entirely different conditions in the years that come after. The disastrous effect of putting new wine in old bottles has its parallel in connection with the use of the new tungsten-carbide cutting alloys at present. For just as the old bottles of Biblical times failed to hold the new wine and so wasted it, old and inadequate machines not only fail to get satisfactory results with the new cutting tools but frequently permit so much vibration of the costly insert of the cutting tool that it is destroyed.

Several cases of this kind have been reported recently. Tools that have done splendid work, when used in lathes of sufficiently rigid design and with spindle and cross slide properly fitted, failed utterly when tried in light machines of older vintage, which could hold neither the work nor the tool as firmly as is necessary.

While there is every indication that the new cuttings tools can be used to advantage in many machine tools now in use, it is probably safe to say that few of these machines are so designed and built as to secure the maximum economies from the new cutting materials. The result of putting new wine in old bottles still has its parallel.

Waste Week

THE Management Division of the American Society of Mechanical Engineers, with the co-operation of the American Management Association, and the endorsement of other groups, has suggested April as Management Month and adopted "Waste Prevention" as the central theme, In many centers the local sections of the American Society of Mechanical Engineering, with the co-operation of members of the other associations have actively taken up the idea and organized to put the plans into effect. The program is planned as an annual observance. It is proposed that some one week during this month be devoted, by each community, to waste prevention.

While meetings on waste prevention, with prominent speakers, will be held in many places, the big feature of the plan is that it becomes a program immediately applicable to each individual manufacturing plant. In 1926 the Westinghouse Electric and Manufacturing Company, at the East Pittsburgh plant, put on a waste prevention program, through the suggestion box idea, in connection with Management Week, that saved $50,000 annually. In 1927 the Newport News Shipbuilding and Dry Dock Company followed a similar plan and the first year realized savings of $80,000, with a prospect of reaching $250,000 when all the ideas received were put into effect. The United States Steel Corporation and its subsidiaries, in the fall of 1928, secured equally remarkable results from a similar program.

There are five elements in the plan which are necessary for success: Active endorsement by the plant management; adequate publicity to get the idea across to the workers; a series of waste exhibits to stimulate interest; suggestion boxes in which workers can place their ideas; prompt and adequate cash rewards as soon as the potential savings from suggestions can be estimated.

· SHOP · EQUIPMENT · NEWS ·

Oliver No. 51 Unit-Type Motor Headstock Lathes

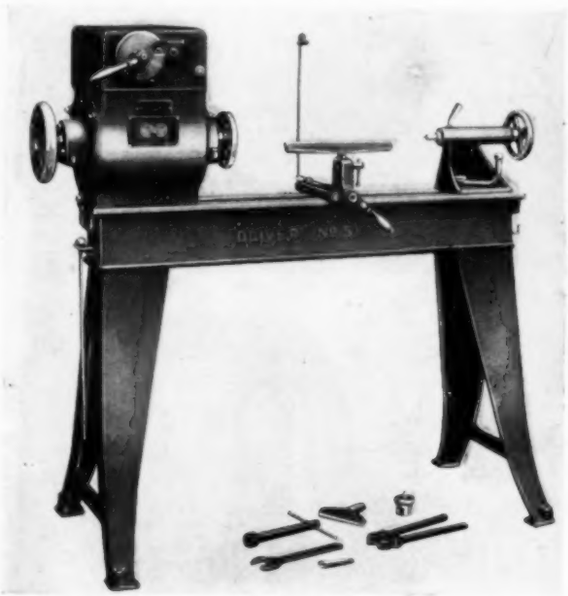
ADJUSTABLE- and the four-speed, unit-type, motor headstock lathes, designated as No. 51 and suitable for a patternmaker's use in particular, have been developed by the Oliver Machinery Company, Grand Rapids, Mich. The construction of the unit head on each type is such that all control mechanisms are placed over the motor, and are inclosed in a cast-iron housing. The adjustable-speed headstock of ½ hp. capacity provides speeds ranging from 600 to 3,600 r.p.m., while the four-speed, ½-hp. headstock gives 600, 1,200, 1,800, and 3,600 r.p.m. Both types have capacities of 12 in. over the bed and 9½ in. over the carriage, and will turn 24 in. between centers on a 48-in. bed, or 36 in. on a 60-in. bed.

The motor itself forms the headstock on the adjustable-speed lathe, and is of the single-phase, series-compensated type. It will operate on single or polyphase circuits having frequencies lying between 25 and 60 cycles. A governor of the centrifugal type is built in as a part of the motor and serves to maintain the speed desired. Speeds may be varied by turning the control handwheel while the motor is running. A pushbutton stop and start switch, with cartridge-type overload protection, is built in as a part of the equipment. A ½-in. hole is bored the entire length of the 1¼-in. steel tube spindle to facilitate the removal of centers. The inside end is threaded for a faceplate, and is bored to receive a No. 2 Morse taper shank. The outside end carries an "Oliver" patented combined handwheel and faceplate.

All controls for the four-speed type of the unit head are located directly above the motor, all wiring between the motor and control being fully inclosed in the cast-iron housing. A drum rotated by the speed lever determines the speed of the motor. This lever is so located with respect to the start button that the motor can be started at 600 r.p.m. only, and can be stopped instantly at any speed. The controller is provided with low-voltage protection, an overload relay with hand reset, and a pushbutton stop-and-start magnetic contactor.

The bed is a cored casting 6¼ in. deep and 6⅝ in. wide, and may be obtained in 48 or 60-in. lengths. The top is planed flat, while the inside edges are machined so as to act as ways for the alignment of the head and tailstock. When furnished with a tool carriage, the ways for the same are cast to the side of the bed. Long legs may be furnished for the lathe so that the bed is 36 in. from the floor, or short bench legs may be obtained if desired. The tailstock is of the open-side design, and is secured to the bed by a positive lever clamp. The 1½-in. tailstock spindle is bored for a No. 2 Morse taper, and has a traverse of 4 in., and on a lathe with a carriage it has a set-over of 1 inch. A hand-feed tool carriage with cross-feed and compound swivel may be furnished. The apron has a travel of 37 in. on a 60-in. bed and is operated by means of a cut steel rack and pinion actuated by a handwheel. Traverse of the cross feed is 5½ in. The compound rest carries the slotted toolpost and has a traverse of 3½ in. Its socket base is graduated and swivels on the cross-slide. On lathes having a tool carriage, the top of the bed and the guide of the cross-slide are graduated in the sixteenths, and the end of the carriage as well as the ends of the cross-slide, are provided with little pointers that may be adjusted to the work.

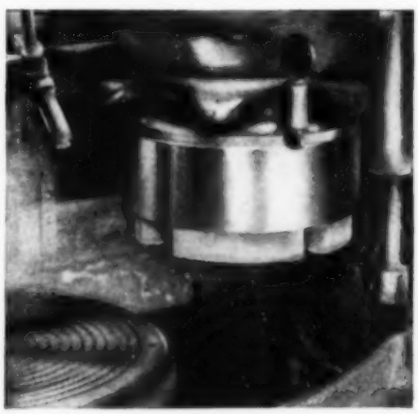
The headstock unit can be removed from the lathe by releasing two-steel straps located underneath the ways of the bed. It is suitable for application to the older belt-driven models.



Oliver No. 51 Four-Speed, Unit Type, Motor Headstock Lathe

Blanchard 11-Inch Segmental Grinding Wheel for No. 10 Surface Grinder

An 11-in. segmental grinding wheel, similar in construction to the 18-in. wheel described on page 555, Vol. 69, of the *American Machinist* and intended for application to the No. 10 surface grinder, has been announced by the Blanchard Machine Company, 64 State St., Cambridge, Mass. This grinding wheel consists of a chuck body carrying four abrasive segments with rounded ends. The face of the body has a circular channel cut in it and this channel is separated into two halves by means of two fixed partitions or abutments secured therein. Two wheel segments are placed in each half, and are held in position by means of a clamping



Blanchard 11-Inch Segmental Grinding Wheel applied to a No. 10 Surface Grinder

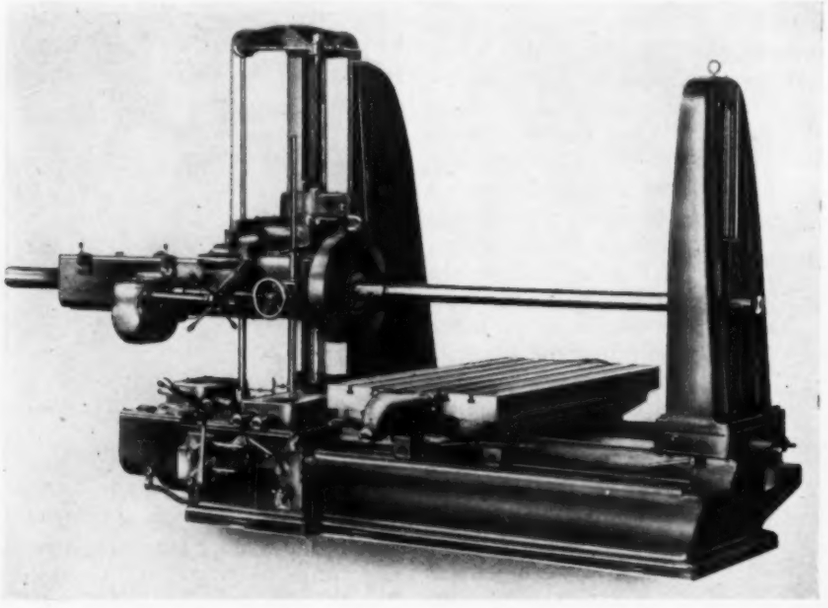
unit between them. These units fit the ends of the segment, and are expanded by means of a wedge and screw. No backing plates or screws are used, as the segments are securely held by the action of the clamping unit, which forces the segment against the fixed abutments and also outward against the outer shell and chuck body. Only two screws need be loosened or tightened, when adjusting or changing the segments. The body is cadmium plated to resist rust and the other parts are made of aluminum bronze, except the screw, which is of stainless steel. Abrasive segments 5 in. deep when new are used, and of this length 4 in. can be worn down.

The entire segment wheel is mounted on the faceplate of the machine in the same manner as the standard ring wheel and can be removed easily at any time. Being machined from a solid steel forging and finished all over, it is balanced, and has ample strength to resist any stresses which might come upon it in service. No change is necessary in the No. 10 grinder when using this wheel. According to the manufacturer, the advantages of its use are: Saving on abrasive cost, especially on work having medium or broad surfaces, and faster, cooler grinding of work having very broad surfaces.

Defiance Improved No. 6 Horizontal Boring Machine with Faceplate Drive

UNIT construction of the head, feed, and speed boxes is employed on the No. 6 improved horizontal boring, milling, and tapping machine announced by the Defiance Machine Works, Defiance, Ohio. These units are thoroughly inclosed, and are provided with forced-feed lubrication, controls are centralized. The revolutions of the main boring spindle in either direction for tapping operations are controlled by one handle conveniently located.

Base, columns and tail support are massive in design, the base being provided with outboard supports giving



Defiance Improved No. 6 Horizontal Boring, Milling, Drilling, and Tapping Machine

ball bearing thrusts on the spindle, and roller bearings on the feed and speed boxes. Independent rapid traverse to the head and platen in all directions at 84 in. per min. is provided, and all feeds, speeds, and hand a maximum width of 54 in. The overhang of the platen is supported by rollers moving on a steel track carried on the outboard supports. Vertical adjustment of the spindle head is 37 in. and the machine is built with three columns of different heights to suit requirements, giving maximum distances from the top of the platen to the center of the spindle of 37, 48, or 60 in. The machine can also be supplied in a range of bed lengths, these being 7, 8, 9, and 10 ft.

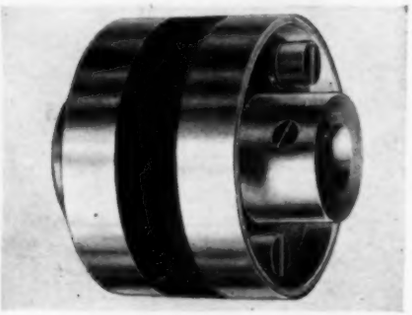
The standard working surface of the platen is 36x75 in., but larger sizes can be supplied to the purchaser's specifications. Maximum distance from the center of the spindle to the top of the bed is 48 in. and the maximum distance from the center of the spindle to the top of the platen is 37 in. The travel of the spindle is 60 in., and it is 4½ in. in diameter.

Ten speed changes ranging from 7½ to 157 r.p.m. are provided when the machine is supplied without a faceplate, backgear drive, while with the backgear the number of speed changes totals 20. Backgear drive is recommended for use with milling cutters over 10 in. in diam. With reference to the feed changes, 12 are provided without the faceplate drive and 24 with the faceplate drive, the range being, in the former case, from 0.006 to 0.495 in., and for the latter, as high as 0.990 in. A 10-hp. motor running at 1,200 r.p.m. is recommended for drive.

With the 7-, 8-, 9- and 10-ft. beds, respectively, net weights range from 31,415 to 36,000 lb. The amounts of floor space occupied range from 19 ft. in length by 108 in. in width, to 22 ft. in length by 108 in. in width.

Ajax Type C Flexible Coupling

A light-duty, inexpensive flexible coupling known as the Type C has been announced by the Ajax Flexible Coupling Company, Westfield, N. Y. This device is intended for fractional and small horsepower ratings

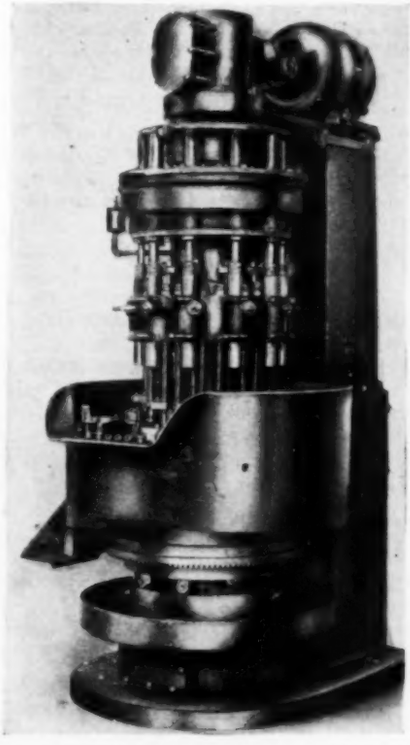


Ajax Type C Flexible Coupling

on equipment requiring an inexpensive connecting unit of positive stability. It is made of two die-cast flanges with wide faces and with the surfaces true to the bore. The two flanges are connected by means of four setscrews, two in each flange, which are screwed into nuts permanently molded into a rubber center piece. This rubber disk acts as a shock-absorbing medium. The coupling is so designed as to correct slight misalignment and to absorb the shocks of starting and stopping. It is made in bores from 1½ to 1¼ inches and in several sizes.

Langelier Multiple-Spindle Continuous Drilling Machine

SEVERAL important improvements in construction, operation and adaptability have been incorporated recently in the multiple-spindle continuous drilling machine made by the Langelier Manufacturing Company, Providnece, R. I. The principle and



Langelier Multiple-Spindle Continuous Drilling Machine

general design of the machine previously described on page 825, Vol. 61, of the *American Machinist* have been retained, but in the unit illustrated the drilling spindle driving mechanism, shown on the top housing, and driven directly by the motor, has been reconstructed so that different drilling speeds can be easily obtained by interchangeable pick-off gears. These gears are totally inclosed, are hardened and run in oil.

The drilling spindle units have been made separate so that the machine can readily be arranged with six, eight or ten working stations, governed by the cycling of work to be drilled. Single drills are shown, but the unit can be adapted for multiple-spindle drilling heads when required. The change can be made easily.

The worktable feed slides have been changed from a round to a rectangular form to keep them rigidly in position while feeding. The worktables are positively fed up and down by rollers which are fulcrumed in the lower end of their slides and which bear on a stationary circular ring cam attached to the base. Fixtures for locating and holding the work are attached to these tables. Each drill spindle has vertical adjustment and has drill-guide, work-clamping jaws. A throw-out clutch has also been put into the feed driving mechanism so that it can be instantly stopped in case of drill breakage.

Chips Removed Quickly

Another improvement is a new form of chip guard surrounding the machine that has been so designed that the chips are carried away as fast as they are made by means of a full flow of cutting lubricant running down the sloping bottom of the guard and out through the side into a tote box, through which the cutting lubricant strains into a tank. The cutting lubricant is forced up through the center of the post to each of the drilling units by a 100-gallon centrifugal pump.

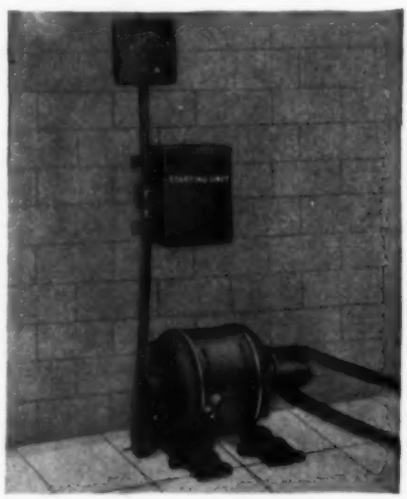
In principle of construction the machine consists of a large round vertical post mounted on top of a rectangular cabinet form of base. About the post revolves a circular carrier to which is attached the drilling units with their worktables and the unit driving mechanism. The carrier revolves upon a large thrust ball bearing and another ball thrust bearing is at the top of the post which is used to supplement the weight of the carrier to resist the cutting thrust of the drills.

The carrier is supported at its top end by a round trunnion running in a bearing which is part of an upright box-type standard that is bolted on top of the base at the rear of the machine. The carrier is driven by a large ring bevel gear bolted to the lower end of the carrier. The gear in turn is driven through a bevel pinion which is part of a reducing train of gears all mounted in a gear box attached as a unit inside of the base at the rear. A shaft projecting from the gear box carries a pulley that is belted to a 2-hp. motor mounted at the side of the upright standard.

The machine is entirely surrounded by guards, not shown in the illustration, with an opening at the front to allow the operator to feed the machine as the work stations are presented, to him. The unit occupies a floor space of 70x74 in., and stands 9 ft., 6 in., high. Its weight is 13,000 pounds.

Howell Type CI "Red Band" Brushless, Single-Phase Motor

Characteristics of operation resembling a polyphase motor are embodied in the Type CI "Red Band" brushless, single-phase motor announced by the Howell Electric Motors Company, Howell, Mich.



Howell Type CI "Red Band" Brushless Single-Phase Motor

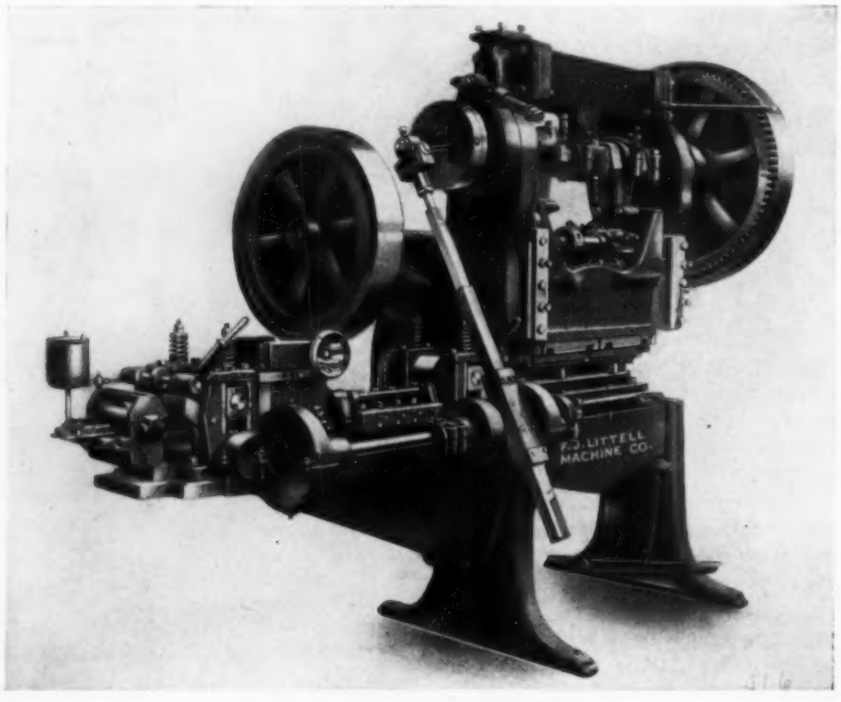
This motor has no brushes, commutator, wire-wound rotor, internal switching device, or soldered rotor contacts. At the same ratings, its starting and pull-out torques, power factors, and efficiencies correspond to those of polyphase motors. All modifications obtainable in polyphase units may be had in this design.

Because of the elimination of sliding contacts, the motor will not spark, a safety feature of value where there is danger of materials exploding or igniting. It can be plugged and reversed at full speed, making it suitable for single-phase operation of hoists and woodworking machines. Its stator windings are similar to an ordinary two-phase motor with a starting condenser connected across one phase. High starting torque is supplied by an external starting unit containing the starting condenser and a simple contactor, which disconnects the reactance automatically from the circuit when the motor comes up to full speed.

Littell No. 5 Punch Press Feed

Coil stock up to $\frac{1}{8}$ in. thick and $\frac{1}{8}$ in. wide can be straightened and flattened, oiled on both sides, cut into the desired lengths up to 36 in., and a large number of holes punched in each piece by means of the Littell No. 5 punch press feed. This mechanism has been developed by the F. J. Littell Machine Company, 4125 Ravenswood Ave., Chicago, Ill. The hardened and ground feed rolls are $5\frac{1}{2}$ in. in diam. by $8\frac{1}{2}$ in. wide and can be made wider if desired. The driving mechanism is made of tool steel, hardened and ground. A speed of 35 to 50 r.p.m. can be maintained by this machine. When operating at about 35 strokes per min., it will deliver approximately 15,000 pieces in a 9-hour shift.

Although such a feed is mounted ordinarily on the bolster plate of the press, in this case it is mounted on a large and heavy semi-steel bracket attached to the side of the machine.



Littell No. 5 Punch Press Feed

REVIEW · OF · RECENT · PATENTS

Relating to the Machinery and Metal Products Industries

Metal-Working Machinery

The Western Electric Co. was assigned a patent, 1,703,300, on an extrusion press, in which the die block is heated electrically and an electrical heating plate is interposed between the die block and the ram.

A special machine for welding wheels to rims was patented, 1,703,588, and assigned to the Budd Wheel Co. In the machine the wheel is supported on an indexing draft, and the two electrodes approach and separate successively and automatically at each indexing of the wheel.

A motor-driven rivet spinning machine was patented, 1,702,750, and assigned to the Black & Decker Manufacturing Co. The motor is supported in the top of the frame, and is geared to the spindle. The anvil is operated by a lever, which multiplies the pressure to compress the rivet between the anvil and the spinning tool.

A spot-welding machine was patented, 1,703,541, and assigned to the Briggs Manufacturing Co. The machine has one electrode supporting arm on the side of the base and the other pivoted on a frame on the top, both insulated.

A portable spot-welding machine was patented, 1,703,683, by Marvin W. Moesta, of Detroit, Mich., has a movable electrode attached to a piston, which slides in a cylinder in the body of the machine.

Parts and Mechanisms

A crossrail clamp for open-side planers was patented, 1,702,471, and assigned to the Shaw-Crane-Putnam Machine Co., Inc. The action of clamping is by means of a cam, which forces a gib into position to clamp the rail on the ways.

A clutch mechanism for presses was patented, 1,702,548, and assigned to the Cleveland Punch & Shear Works Co. In the clutch one member has driving projections facing an annular enlargement in the other member, which has keyways into which keys are arranged to engage and disengage. The rotation of the collar will move the keys in and out.

A double helical or double spiral gear of herringbone type was patented, 1,702,860, by Paul Bottcher, of Altona-Bahrenfeld, Germany. The gear is generated from a rack or crown wheel as a basis, and has flanks shaped to a portion of a hypotrochoid.

A holder for grinding thread-chasing dies was patented, 1,703,017 by Frederick M. Singer, of Racine, Wis. The holder consists of a head, which sets on the table of the machine, and has an indexing member with provision for holding the parts to be ground.

A machine tool table, of bottom-tapered section and having strengthening ribs, was patented, 1,702,374, and assigned to the Kearney & Trecker Corporation.

News of the Week

Apprentice and Foreman Training Discussed by Educators

SPEAKING on "Industry and Apprentice Training" at a conference on industrial, technical and business education, held April 3-5, in New York, Magnus W. Alexander, president of the National Industrial Conference Board, complained of the apparent lack of appreciation of industrial work as a vocation among modern youth. He said that the demand for skilled labor exceeded the supply and that a serious problem was presented by the unwillingness of many young people to undertake industrial apprenticeship training. The problem today is not so much one of methods of training apprentices which are now being developed to a high degree by far seeing industrial managers and educators, but is rather one of obtaining apprentices willing to undergo the requisite period of training, according to Mr. Alexander.

Vocational Guidance

Schools can co-operate with industry and do much to create an increasing interest in and respect and admiration for industrial vocations, a greater appreciation of the importance of the potential earning power and of the opportunities for promotion of the skilled worker in industry. By proper instruction in the real functions and possibilities of industrial vocation, the public school could lay a sound foundation for vocational guidance, avoiding or overcoming psychological resistance among boys and girls against perhaps the very best occupation they are fitted for. This mechanistic age has created too much of a psychology considering manual work of any kind unimportant and out of fashion. Common labor will continue to be more and more relegated by the machine, but the skilled mechanic by the same token, will become more and more important, Mr. Alexander believed.

Another speaker, Layton S. Hawkins of the Rossman Corporation, declared that employers did not find it economically feasible to train industrial apprentices and that the problem must be solved by industrial schools, which he urged to prepare finished skilled workmen capable of really earning the wages paid by the employers.

Foremen Training was the subject of the last session of the conference, at which "Management's Responsibility for a Foreman Training Program," "What Foremen Conferences Can Do For Management," the "Place of Foremen Conferences in a Training Program," and "Foremen Conferences in New York State" were discussed from several angles. It was agreed that foremen conferences could be of great value but that to get the best results they should be carefully planned to bring out the essential features and to emphasize the points being considered. Unless the conferences are well planned, much of their value is sure to be lost.

One of the urgent needs in many plants is a definite outline of the duties of the foreman, which vary from that of a gang boss to that of assistant superintendent. In view of this difference, and also to make it easier to have the conferences include higher officials, it was suggested that "Supervisory Conferences" would be a more satisfactory designation for such meetings. The need for both the interest and attendance of higher executives was urged as a means of informing the foremen as to company aims and policies.

The necessity for an understanding of the human problem, of tact in handling men, of a knowledge of the work so as to instruct and interest the men, were emphasized as qualities necessary for a good foreman. Some felt that no one could train apprentices so effectively as the foremen. This does not agree with all theories and practices, and often imposes an added burden that can easily be detrimental to both foreman and apprentice.

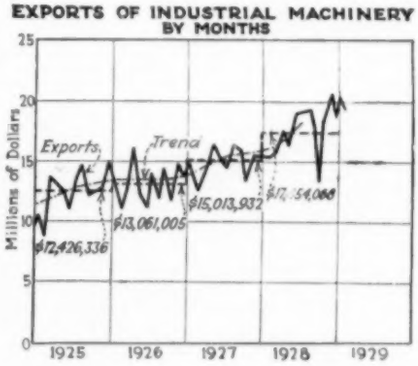
The foreman conference idea frequently needs to be sold both to the foreman and to management. A definite program will usually put it over in both cases, even though the results may be more or less intangible. Good ideas that were stimulated by the conferences frequently do not appear for some time in the form of definite improvement. But when the foremen are given the opportunity to broaden their knowledge on such plant problems as overhead and labor turnover, the result is usually a greater interest, and the development of ideas that help the work in one way or another. The need for understudies was brought out, and the fact that in training these men the foreman usually gets a more definite idea of his own duties and responsibilities.

To Broadcast "Safety"

"Universal Safety" will soon be carried directly into millions of American homes, through a series of thirteen weekly radio addresses by national leaders the first of whom will be Charles M. Schwab, on Saturday evening, April 20, at 7:00 p.m. The National Broadcasting Co., in co-operation with the National Safety Council will present this "Universal Safety Series" in an effort to awaken interest in this national problem. In addition to Mr. Schwab, who will discuss "Safety as a Factor in Industry," the following speakers are announced: Hon. Robert P. Lamont, Secretary of Commerce: "Safety as a National Problem." Hon. James J. Davis, Secretary of Labor: "Safety and the Worker," and others. Approximately thirty broadcasting stations will be in the hook-up. The underlying purpose of this new service for radio is to plant the seed of safety thought in the mind of the individual citizen.

Machinery Exports Still on Upward Trend

Exports of industrial machinery during February continued the upward trend noticeable since 1922, totaling $19,562,000, or an increase of 30 per cent over the corresponding month of 1928. As compared with January, 1929, however, the February total fell by $1,214,000, but it was a very good showing considering that February is a short month. This trade is subject to constant fluctuations from month to month and therefore slight variations in the monthly totals, while of current interest, have no particular significance in gaging the general trends. A better idea can be obtained from the accompanying chart by taking into consideration



monthly averages for preceding years. On this basis machinery exports during February exceeded the monthly average for 1928 by $2,108,000 and for 1927 by $4,548,000, besides showing still more striking gains over previous years.

With the single minor exception of water wheels and water turbines, exports of all the principal classes of industrial machinery showed marked gains over February, 1928. Oil well and refinery machinery, power pumping equipment, metal-working machinery and construction and conveying machinery provided the outstanding example, but steam engines, internal combustion

engines, and mining and quarrying machinery also contributed substantially to the general total. Exports of oil well drilling apparatus during February, 1929, showed a gain of over 70 per cent above the corresponding month of the preceding year, but the greatest increase under this general heading took place among the unclassified items, exports of which nearly tripled.

A few declines appeared in the metal-working machinery group, but in general the trend is upward, total exports having exceeded those for February, 1928, by $767,000 or about 32 per cent. Of the important items in this group, shipments of gear-cutting machines increased from $87,000 to $108,000; planers and shapers from $79,000 to $100,000; internal grinding machines from $88,000 to $132,000; and pneumatic tools from $112,000 to $201,000, while exports of rolling mill machinery and foundry and molding equipment nearly doubled, and those of sheet and plate metal-working machines almost tripled in value.

The sharp upward export trend in the construction machinery group continued during February, shipments rising by more than 45 per cent over February, 1928. While exports of excavators, including power shovels, fell off from $608,000 to $351,000, those of concrete mixers and road rollers nearly quadrupled. Moreover, shipments of cranes were nearly five times and those of freight and passenger elevators six times greater than in February a year ago.

Under mining machinery, rock drills, coal cutters and concentrating and smelting machinery showed declines under February of 1928, but mine hoists and derricks continued the upward movement. Similarly, foreign shipments of ore crushing and sorting machinery rose considerably. Exports of pumping equipment showed gains practically all along the line, the most notable being that for centrifugal pumps.

Other marked increases occurred in the case of wood-working machinery, refrigerating equipment, air compressors and ball and roller bearings and parts, while exports of iron and steel body valves increased more than three times and those of laundry machinery five times over similar shipments for February last year.

Group Insurance Adopted by the Oilgear Co.

The entire personnal of the Oilgear Co., of Milwaukee, Wis., is participating in the benefits of a combined group life, health and non-occupational accident insurance program recently installed through contract with their employer and the Metropolitan Life Insurance Co. The total amount of life insurance established by the plan exceeds $690,000. A feature of the plan is the co-operative method of paying premiums. By this arrangement, the employer substantially augments the employees' contributions toward the cost.

Improvement in British Machine Tool Trade

For several years past, the British machine tool trade has shown a steady improvement, and most companies continue to be well employed, according to a statement, which recently appeared in *British Industries*, by Sir Alfred Herbert, president of the Machine Tool Trades Association. In several cases night shifts are being worked and orders are coming in at a satisfactory rate. The prophesy made by him two or three years ago that prices would tend to harden has, to some small extent, been fulfilled, and he predicts that further advances will probably be made, as it is generally felt throughout the trade that the margin of profit is inadequate, and, moreover, prices of materials have shown an upward tendency. The industries had a series of very lean years after the War, owing to large accumulations of wartime stock both at home and abroad. Foreign trade was also depressed, and these adverse factors kept prices at a very low level.

He explains that the demand for machine tools is as good as it is, despite the unsatisfactory condition of some of the most important industries in Great Britain, because the machine tool user has become more and more convinced that his plant must be kept efficient and that old and obsolete machines must be continually weeded out and replaced by the best models available. He also reports the almost complete absence of trade disputes, a condition he attributes to the spirit of co-operation on both sides. He also finds a growing recognition on the part of employers that their working people must be allowed some shares in the benefit of increased production. It is his opinion that when a new machine is installed and the output increased, piecework rates should be such as to allow the workers to earn a higher rate of pay than they were getting when the less efficient machine was in use.

Financial Notes

The report of the American Chain Co., Inc., and subsidiaries for year ended December 31, 1928, shows net income of $410,842 after depreciation, amortization, interest and federal taxes. This compares with net income of $2,022,811 in 1927.

The report of the American Machine & Foundry Co. and subsidiaries for year ended December 31, 1928, shows net profit of $1,428,161 after depreciation, federal taxes, etc. This compares with $1,418,970 in 1927. During 1928, patents valued at $4,593,141 were written down to $1.

The report of the Remington Arms Co. for year ended December 31, 1928, shows consolidated net profit of $1,887,264 after depreciation, interest, federal taxes, etc. The above figures are exclusive of a non-recurring profit of $700,000 on stock of Remington Service Machines, Inc., exchanged for voting trust certificates for stock of Consolidated Automatic Merchandising Corp. In 1927 net profit was $640,442.

The report of the Eastman Kodak Co. for year ended December 31, 1928, shows net profit of $20,110,440 after depreciation, federal taxes, etc. This compares with $20,142,161 in 1927.

The Electric Boat Co. and subsidiaries, exclusive of the New England Ship and Engine Co. report for 1928 a consolidated profit of $941,813 after charges, compared with $438,018 in 1927.

The 1928 report of the Crosley Radio Corporation shows an increase of 389 per cent in net profits as compared with 1927, while net sales increased 118 per cent. In 1928 net profit was to equal $6.93 a share as against $1.41 a share in 1927.

Chemical Exposition in New York

Over forty industries furnishing material and equipment will display their products at the twelfth exposition of the chemical industries, to be held at the Grand Central Palace in New York during the week of May. 6. Of chief interest to the metal-working field will be the exhibits of metals and other raw and processed materials used in manufacture.

Lincoln to Expand Welding School

To meet the rapidly increasing demand for practical instruction in arc welding, the welding school maintained by the Lincoln Electric Co., Cleveland, is expanding its facilities, and it is expected that before the year is over more than twice the present welding equipment will be installed. At present there is a waiting list, and it is to take care of the demand by manufacturers for skilled arc welders that the present expansion is being made. The course is six weeks in duration and is practical in character. No tuition fee is charged, but students are required to keep the usual shop hours. Individual rather than class instruction is given. The school is under the supervision of Arthur E. Madison.

Railroad Equipment Demand Increasing

Freight cars on order on March 1, 1929, by railroads of this country numbered 37,820 as against 21,726 on this date last year, according to the American Railway Association. The month previous 30,216 freight cars were on order. Locomotives on order on March 1 numbered 291 compared with 171 a year ago. New or rebuilt locomotives placed in service the first two months of 1929 totaled 80.

General Metal-Working Activity in France, Although Prosperity Lags

By Our Paris Correspondent

FRENCH economists and industrial experts are now able to take note that last year's operations have not brought about that encouraging prosperity which will assure a steady march forward. Ground has been lost in many export lines affecting the metal-working trades and the domestic market has been handicapped by the selling prices of consumer goods. This condition has tended to discourage any disposition to install new equipment which might reduce production costs, except in certain exceptional instances. Successful efforts already made have been the greatest inducement for followers of those who have taken the first steps, but more elastic credits for equipment and a larger buying power on the part of the consumer are two elements that the smaller industries have not always been able to combat.

German payments in kind on reparations account are still being loudly criticized. Once again, and more than ever, is this true since echoes of similar plaints are heard from British industries whose trade in France has been affected. In the case of French industries, their plaints are apparently justified. It will help the trade of all the world, though it may not facilitate German payments of war indemnities, if this procedure is abolished or attenuated by ruling of the reparations and indemnities commission of experts now sitting in Paris.

Even the American experts, whether inspired by the demands of American industry or not, appear to recognize this situation, though the point has not been loudly emphasized. The French themselves are divided on the issue, but the opposition thereto is the stronger. One manufacturer of electric cranes in the Loire Valley points proudly to the fact that he has more than met this competition from across the Rhine and secured orders for eight important units from a shipbuilding firm. On so important an order this forms an exception rather than the usual outcome.

The revised final (French) figures of imports from the United States are as follows:

	1927		1928	
	Metric Tons	Value, Francs	Metric Tons	Value, Francs
Machinery and parts	19,918	293,812,000	17,169	388,737,000
Tools and mfrs. of metal	3,016	72,980,000	2,573	61,836,000
Percentages of imports from the United States as compared with total imports of similar goods:				
Machinery and parts	18	23	14	21
Tools and mfrs. of metal	9	20	5.1	14

These percentages show once again that it is the higher priced machine and tool that is bought in America. Good representation accounts for some of this, but more is accounted for by the efficiency of the machines themselves. Other nations producing similar goods are quite as keen in their representation. In spite of the increase in value of machinery imports from the United States in 1928, the percentage of the total value of such imports fell off 2 per cent nevertheless, accounted for perhaps by a slight lowering of prices or a slight drop in the value of the franc after stabilization in the spring of last year.

Exports of machinery parts and tools from France to the United States in 1928 represented virtually 3 per cent of the total of such exports.

Machine tools for metal-working in general bulk more as to imports in 1928 than in exports. Woodworking machinery shows a big excess in volume of exports—2,127 metric tons as against 744 tons imported. Most other tool and equipment items show an excess of imports over exports. Weighing and conveying machinery show a very large volume of exports as compared with imports. Prime movers and accessories, including Diesel and other internal combustion motors, about balance as to imports and exports, as virtually they have during the past three years, in volume being approximately 5,000 metric tons.

Raw material exports in 1928, taking iron ore and metallurgical products as a base, show an increase. What is serious is that high-priced manufactured goods of metal show a falling off. What encouragement there has been in the heavy industries in France has been brought into being largely by domestic consumption demands, though this, for the major part, has left many of them quite up in the air as to foreign markets.

The metallurgical industries threaten a rise in prices of semi-manufactured materials which when, or if, it comes will bring in its train increased prices for fabricated and transformed metals in the last resort. No one wants this at the present time. The buying public genuinely believes that it is carrying its share of the load already.

If the labor situation is not notably bad, it is nevertheless changing its ratio of supply and demand. At the first of this year there was a complete turnabout of the proportion compared with the year before, due, it is believed, by a sort of "tread water" policy on the part of many industries pending the turn of the government's fiscal policies and such new arrangements as are to be made respecting the payment of war indemnities in kind.

Continued application of the 44-hour week is problematic; even now a 96-hour fortnight is in practice in certain districts. The Minister of Labor has stated publicly that toleration of supplementary hours is likely to be suppressed owing to the demands of the workers' syndicates.

The General Workers Confederation is frankly against increasing the contingent of foreign labor to be brought into the country, taking this stand as a sort of club to attain a new wage scale for their members. There has been a rumor of an accord with the Austrian government whereby 12,000 Austrian laborers for the mines, metal trades and building trades are to be brought in. Public opinion is divided as to the apparent necessity of this, but the unions are frankly against it.

There has been much criticism of French automobile makers by reason of long delivery delays. Obviously this is chiefly caused by the labor factor. The solution is obviously more and better machinery and handling equipment.

The situation in the railway rolling stock plants is considered favorable but nothing seems to indicate a need of any great additions in the way of equipment. There is a movement clearly defined among the seven trunk railway systems of the country for the ultimate equipment of all passenger trains with all-steel cars. It is possible that this in the long run will demand new production equipment. Roller bearings for axles are being talked of, studied and experimented with, and something may be looked for in this direction.

French agricultural machinery manufacturers have virtually doubled the volume of their exports during the past fifteen years, indicating the growth of the industry, due largely to increased sales in home markets. An almost contrariwise percentage is shown with respect to imports in this line.

The machine tool trade is, if not booming, considered as normally satisfactory with prices on import units and those normally produced in the country showing a tendency to rise. Trade volume is satisfactory in small tools.

Again economic, wage-earning and employing circles are hard hit by the March index figures of costs. In three months the general wholesale index has risen from 637 to 652; national products from 631 to 648; imported products from 646 to 652; general food stuffs from 589 to 611; industrial materials in general from 679 to 687 and minerals and metals from 609 to 627. Retail prices have accordingly risen from a minimum of 4 points to a maximum of 17 points with indications that they will go still higher.

Signs point to the fact that the wage earner is shortly going to ask for the wherewithal to meet these steadily increasing living charges. It has been stated by authorities that the wage scale has followed the living scale but if so the observation must apply to certain regions, possibly certain industries, and is by no means universal. If an increased wage scale comes into being accompanied by a rise in the cost of semi-finished products for transformation manufacturing industries will be bound to slow down because of a still greater restricted market.

BUSINESS BAROMETER . . . . *Many commentators are pointing out that the present activity cannot be sustained without causing an unhealthy accumulation of stocks*

By THEODORE H. PRICE
Editor, Commerce and Finance, New York

From this page the reader will get a quick picture of current business and industry. The boxed material below is a summary of the letters from regional correspondents of the American Machinist, published in full on the opposite page.

WILL ROGERS says "There are two things that can disrupt business in this country. One is war and the other is a meeting of the Federal Reserve Bank."

As the Federal Reserve authorities were in session during most of last week business was acutely nervous. In some of the commodity markets, particularly the grains, cotton and rubber, sharp declines occurred. The stock market also opened the week with a severe decline, but the worst expectations were quickly reflected in prices and thereafter it was firmer.

The anxiety with which Reserve officials' meetings is watched is due of course to the fear that the Banks will soon begin to raise their rediscount rates. But opinions as to the wisdom of such action are divided not only without the System but within it. Those who oppose an advance are politically more powerful than those who favor it and they can bring many impressive arguments to their support. Therefore no certain conclusion that rates will be raised in the near future seems justified.

The Board has issued another warning in which it says that if the member banks do not continue voluntarily to reduce their brokers' loans the System "may adopt other methods of influencing the situation." But as the authorities are so concerned to keep money as cheap as possible for business, these "other methods" are more likely to take the form of an outright refusal to rediscount for recalcitrant members than of a raise in rates. For such a refusal there seems to be authority in the Federal Reserve Act, though its invocation would doubtless raise a storm which might lead to revision of the law.

And there are reasons for believing that even if rates are raised the advance may not be as depressing as many fear. One is that it has been talked about so long that most of its effect has already been dissipated, for it is a truism of the speculative markets that anticipation is worse than realization.

Another reason is that a higher rediscount rate would be merely an admission that a condition of stringency exists; it would come too late to be a cause of it. If the member banks wished to borrow from the Reserve Banks in order to lend to the stock market at rates ranging from 8 up to 20 per cent, they would do so just as freely at a 6 per cent rediscount rate as at 5 per cent.

The fact is that the Reserve Banks, by their policy of depending upon the voluntary co-operation of the member banks to restrict speculative loans on stocks, have committed the money markets to the member banks' keeping, and for the present at least the course of business will be shaped not so much by Federal Reserve plans as by the policies of the great banks in New York.

Except for the competition of the individuals and corporations whose funds are attracted to the stock market by high rates, these banks have the situation in their hands. Their policy is obviously to keep call money firm without relief until a panic rate is threatened, while they supply commercial borrowers at a reasonable charge. If they can carry it out successfully, the effect should be a gradual decline in the stock market that will not much disturb general business.

Therefore the writer is what might be called a conservative reactionary in so far as the stock market is concerned. But he is convinced that after the experience of March 26 the banks will supply credit whenever it shall become necessary to cushion the decline and to keep liquidation orderly, and if that is the case business has little fresh reason to fear the future, or to expect more than the moderate recession that will be necessary to correct overproduction.

Meanwhile the United States is still receiving gold. Last week $13,533,000 which had been earmarked for export at the New York Reserve Bank was released and returned to its reserves, and more is on the way from Argentina. Many of the foreign exchanges are flirting with the gold shipment point and some of the countries affected have had to take steps to protect their holdings.

Reports from industry are almost uniformly glowing, although more commentators are pointing out that the present activity cannot be sustained many months longer without causing an unhealthy accumulation of stocks. As the executives of the industries affected are as well-informed of this condition as anyone else, curtailment will probably be resorted to before this occurs.

The automobile industry is the principal case in point. The output in the United States and Canada in March is estimated by the National Automobile Chamber of Commerce at 595,000 units, which is 20 per cent larger than in any previous month in our history and brings the total for the first quarter to more than 1,500,000. This is at the rate of 6,000,000 for the year, and the March total was at the rate of 7,000,000, whereas it is improbable that more than 5,000,000 will be sold this year. Hence the prediction by a trade journal that production will be reduced within ninety days is probably conservative.

And in iron and steel the leading trade report comments on "the extent to which consumers have departed from a hand-to-mouth buying policy," which is an incentive to present over-production at the expense of the future. But in this industry the manufacturers still have sufficient unfilled orders to keep them busy for some time to come.

ON THE whole the high level of machine tool sales found in the first three months of the year is being maintained as the second quarter is entered, and there is apparently no let-up in the present buying activity in sight. About the only center reporting March sales less than those of the two previous months is Buffalo, where conditions are considered very satisfactory, nevertheless, after a record-breaking February. There is an almost universal opinion that this activity will be continued indefinitely, despite the fact that an extraordinary amount of orders has been placed to date. It is apparent also that the credit situation of the stock market is having little effect upon metal-working activity or machinery sales.

DELIVERIES are rapidly becoming the sore spot of the whole situation. Manufacturers all over the country report steadily mounting numbers of unfilled orders, with production far behind in the race. Employment is at a peak in all centers, and it appears that a saturation point is being reached in the market for skilled mechanics. Night work is being used almost universally in an effort to meet the unprecedented demand for production equipment.

RAILROADS in the Chicago district have been buying against lists issued earlier in the year, but in other quarters such purchases are not up to expectations.

THE aeronautical industry which furnished much business for the machine tool builders in equipping engine plants in the past year is offering further opportunity for sales in the way of small machines for service shops at the principal airports.

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The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

CHICAGO

The first few days of April find business in machine tools keeping up to the average of the last three months. No recession in sales is reported from any source, and present indications point to a continuance of activity all along the line in metal-working tools. Inquiries are being received in good volume, and include shop equipment of all types. The business now coming in is from a wide area of territory, the Chicago industrial district being well represented in the number of sales booked. Industrialists still lead in inquiries, with automotive and automobile accessory interests closely following.

Railroad buying against lists previously issued is reported as satisfactory, the Chicago, Milwaukee, St. Paul & Pacific, the Chicago, Burlington & Quincy, and the Chicago & Northwestern being among the roads interested in the market.

Used tools are in excellent demand. Overdue and long delayed deliveries of new equipment are being held responsible for present activity in second-hand goods. A marked feeling of optimism regarding the future of the machine tool industry is uniformly expressed, and is not now limited to the first half of the year, as up to within a short time it has been.

BUFFALO

While not up to the first two months of the year in volume of sales, March did, however, produce a rather satisfactory amount of business for Buffalo machine tool dealers. The slight tapering off in activity and demand was somewhat expected and predicted in some quarters on the theory that one cannot ride on the crest of the wave at all times.

There was renewed activity in the airplane field during and following the Buffalo aviation show, which is said to have been the best one ever held in this country excepting the one at Chicago. A large number of planes were sold and shortly after the show the Elias Aircraft & Manufacturing Corporation, succeeding the firm of G. Elias & Bros., Inc., announced a large program of expansion and the organization of an effective group of distributors. It is reported that a factory with 200,000 sq.ft. of floor space will be erected, capable of producing 1,000 planes and air-cooled aircraft motors annually. Since 1920 this company has been building airplanes and parts, chiefly for the government. Now it is entering upon a phase of expansion in the civilian field as well.

Spring has come to Buffalo a month earlier than usual this year with resulting increase of activity on the part of contractors and somewhat increased demand for equipment in this field.

MILWAUKEE

The fact that orders for machine tools continue to form a very large volume, in the face of the relatively huge purchases that already have been made, has given the trade cause for reflection. There probably never has been a period in peacetime when a buying movement of the present proportions has occurred, or one that has been sustained at the present high peak for so great a length of time. That instead of being confined to a few important lines, it should extend to virtually every classification of the metal trades, is an unusual feature of the situation upon which are based hopes that a declining demand is yet in the distance.

Metal trades industries were mainly responsible for an increase of more than 1,000 in the Milwaukee payroll during March, the fourth consecutive month in which a new all-time peak was established. The number at work on April 1 is officially reported at 43,226, a gain of 1,083 over the March 1 report, and an increase of 6,343, or 17 per cent, over April 1, 1928. Still there is much complaint over the acute shortage of skilled workers for metal-working shops, especially among makers of machine tools. Practically all of the calls for additional labor that are being received by the government employment office come from machine shops.

The beginning of April found most machine tool shops farther behind on deliveries than at any time since this situation was created by the inability to cope with the rush of orders. In a number of instances, shops have enough business on their books to require capacity operations for six months were no fresh business received or no cancellations encountered.

NEW ENGLAND

The past week was consistently good among machine builders in New England. Inquiries are numerous, but many have strings attached with delivery the chief factor. Orders are also being placed conditionally. The steady booking of single tools has abated to little or no extent, and forms a large percentage of New England business. Leaders in the field predict April will be a strong month for the industry.

Dealers in the used tool field had a quiet week, one dealer says, his smallest week since January. There is still a strong demand for modern used tools in first-class condition, however, and those dealers able to supply this demand command top prices. All in all, the price situation in the second-hand equipment field has improved steadily. On the other hand there are plenty of machines hard to dispose of at a reasonable price.

The unfilled list of orders, most builders find, is increasing rather than diminishing. An unprecedented first quarter of business is responsible for this situation. One executive remarks: "We were never more busy in the history of the company, and anticipate expansion." The Pratt & Whitney Aircraft Co., Hartford, has a growing list of orders for Hornet and Wasp engines. An order for 50 Wasps was received during the week from the Pan American Airways, Inc.

PHILADELPHIA

The note of optimism that machinery and machine tool manufacturers sounded some months ago has been fully justified by the business received during the last few weeks, according to a survey of the market conditions in this area. The revival of industrial activity has been reflected in a large volume of orders and inquiries which dealers in this market have received. With few exceptions indications are that the buying will continue for an indefinite period.

One of the leading aircraft producing companies purchased its shop equipment from a Philadelphia dealer during the last two weeks. Automobile accessory factories were also in the market, and there were some orders for portable tools for locomotive repair shops. Industrial machinery has been selling quite well, with orders coming from Middle Western centers. There has been some rather brisk demand for agriculture tools in this market also.

The bright spots for the immediate future appears to be the aircraft industry, automobile producers, and those engaged in general industrial lines. Those in touch with the railroad situation do not look for many of the larger carriers to enter the market except for immediate needs in the near future.

CINCINNATI

Without exception, the machine tool manufacturers in the Cincinnati district report of the booking of a good volume of business in the past week. In a few cases it was reported that in the week there was a slight increase in sales and in no case was it reported that there was a falling off in the demand.

No indication of a decreased demand is seen, the consensus being that sales will continue at a good level for an indefinite period. A year ago, it is pointed out, there was a flurry in the stock market, resembling the present one, and as it did not affect the demand for machine tools, the present flurry is not expected to have any bad influence. On the other hand, some feel that the machine tool trade will benefit by the deflation that has been taking place.

Selling agents report that in the past week they had approximately the same volume of business as in the previous week, in which period sales were at a good level. General conditions continued to improve in local and adjacent territory, it is stated, and the outlook seems to be very bright.

Orders received in the week came from all sections of the country, being largely for single tools. Railroads bought sparingly. Orders from the automotive field increased in number, but the requirements were not large in any case.

The week's inquiries were pronounced very satisfactory, both as to number and tone.

CLEVELAND

Sales of tools and machinery tapered off slightly during the first few days of April, but this condition was probably more noticeable due to abnormal amount of orders that came into the local market during the past two months. Business for the first quarter of the year exceeded all expectations. Reports of sales records show that business for the first three months was more than satisfactory in virtually all lines of the tool industry.

A local dealer states that March has been the best month of the past three years, with the past quarter equaling any quarter of 1928. Another dealer sums it up by stating that business has been wonderful. Records of an automatic manufacturer showed sales gains of 20 per cent over the last quarter of 1928. Production is on a high level with some concerns booked solid with orders until the middle of June.

The increased demand by automobile manufacturers for labor-saving equipment is responsible for the better portion of the present machine tool prosperity. Some apprehension of a recession due to overproduction in the automobile line is being manifested.

The Murray Ohio Co. is installing the largest double-action punch press in the country. The machine weighs 275,000 lb. and is 28 feet high. The Hupp-Chandler Corporation recently awarded a contract

for a large factory addition, and extensive purchases of new tools are being made.

According to a report of the American Plan Association, employment conditions in Cleveland reached a higher level in March than in the corresponding month of any in the last three years.

DETROIT

The machinery and machine tool market in this area is holding up remarkably well, and while no very great increases in business have been noted within the past ten days or two weeks there is a definitely favorable trend to the market, and dealers here are of the opinion that conditions will improve rather than slacken in the next few months.

In general it is felt that the first quarter of 1929 shows up better than the corresponding period last year. Orders have been better and the volume of business has been higher. There is every likelihood that when the actual computations have been made the first quarter will prove to be one of the most prosperous, if not easily *the* most prosperous of any similar period in the history of the industry.

Almost without exception the automobile and accessory plants are working at capacity. All of them are in the market for equipment of various kinds, and while there have been no spectacular purchases within the past few weeks the general level has been good.

A great many automobile manufacturers Corporation at South Bend also is working kind or another and nearly all of them are buying equipment. Replacement equipment is also playing a very big part in the total sales recorded here. As always, however, there is little or no activity in the machinery and machine tool field outside of the automotive industry.

Probably the outstanding development during the past few weeks has been the large increase in the business derived from small tool and die shops and from the makers of a variety of accessories in Detroit and throughout the state. Nearly all of these firms are prospering and most of them are in the market for equipment.

NEW YORK

Most dealers and factory representatives in the metropolitan district found March to have been the best month since the War, or in some cases in their history, as far as the volume of sales of machine tools went. As has been the case for some months, the sources of buying were well scattered, and in the majority of instances only one or two tools were involved. It is apparent that most metal-working shops are busy and are taking opportunity of present prosperity to revamp their production equipment. No let-up in this unusual sales activity is foreseen for some time, and it is fully expected that the second quarter will measure up to the first in volume of business placed.

With few exceptions deliveries are steadily falling behind, and some orders are being lost on this account. Shipments are in good volume, although some dealers are having difficulty in getting the manufacturers they represent to hold to the promised delivery dates. Deliveries of certain types of machines, notably horizontal boring mills, run as far as six months behind.

Sales made by the Triplex Machine Tool Co. included: one Swiss jig borer, eight Edlund drill presses, an Ames bench miller, an Ames bench lathe, a bench drill press, a "General" flexible power press, and a Rivett internal grinder.

INDIANAPOLIS

Business in this section continues to improve to some extent and in some lines of machinery and machine tools the demand is very gratifying. The increased activity in Indiana in the matter of new airports has developed a demand for small tools to be used in making temporary repairs that is somewhat of a surprise to many of the trade here. All over the state airports are being established and hangars built. Generally each hangar is equipped with a rather complete machine department, hence the new demand, which has been particularly noticeable during the past few weeks. The Curtiss Flying Service of Indiana has just announced it will erect a mammouth hangar in Indianapolis which will be the last word in machine shop equipment as well as other facilities.

The demand from the automobile trade continues to increase. Virtually every factory in Indiana is a ready buyer of tools and some of them are increasing production. The Marmon plant here now is turning out 250 cars a day, a record production for the past few years. The Studebaker Corporation at South Bend also is working to capacity. The Auburn plant reports the same activity and recent purchases in Connersville, Ind., have put back into production two former automobile plants that had been shut down for some years, namely the Lexington and the McFarlan plants. Much new equipment was installed in each plant before they started operations.

Demand from the construction interests for special machinery is increasing rapidly with the coming of warm weather. The same might be said for sales of small machine shop equipment to garages.

Railroads are cautious in their buying, but a considerable volume of special equipment is being sold to the electric interurbans and the electric power and gas companies, where extensive repairs and additions are being started. The radio industry continues to be a good buyer.

Business Items

The Keller Mechanical Engineering Corporation, Brooklyn, N. Y., has arranged to take care of the territories heretofore served by the W. E. Shipley Machinery Co., Philadelphia; Henry Prentiss & Co., of New York; and the Marshall and Huschart Machinery Co., Chicago. Arthur Jenner, who will be located in Philadelphia will handle eastern Pennsylvania, New Jersey, Maryland, Delaware and the Metropolitan District of New York. W. L. MacRae of Syracuse will have the balance of New York State, while P. C. Renno will locate in Chicago, and will cover the northern part of Indiana, the western half of Michigan, and the states Illinois and Wisconsin.

The Allison Engineering Co. of Indianapolis has purchased a tract of 11 acres adjoining its present plant northwest of the city. Announcement that the Allison company had been sold to outside interests for the purpose of starting manufacture of airplane engines was made sometime before. Thus far, however, identify of the buyers has not been disclosed, but there has been confirmation that Eddie Rickenbacker figured in the deal for the purchase of the plant and grounds.

The Waterloo (Iowa) Steam Boiler Works, has added automatic stokers, smokeless furnaces and sectional steel heating boilers to its line of products and will construct a larger factory upon site yet to be selected, increasing its work force 10 to 25 men during the next eight months. W. C. Smith, manager, is in charge of plans for the expansion.

Consolidation of the Kelsey Hayes Wheel Corporation, Detroit, and the Wire Wheel Corporation of America, Buffalo, has been approved by the boards of directors of the companies. A new corporation, which will unite the two present companies, will be known as the Kelsey Hayes Wheel Corporation and will have an annual capacity of more than 2,150,000 sets of wheels, as well as brake drums and other automobile parts.

The Roller-Smith Co., 233 Broadway, New York, has appointed the following district sales agents: Jackson Brown, Jr., 701 Kittridge Bldg., Denver, Colo., for the states of Colorado, Utah, Wyoming, and New Mexico; Carl P. Lohr, 401 National Bank of Commerce Bldg., St. Louis, for the St. Louis territory; and J. C. McDougall, Alaska Bldg., Seattle, Wash., for the states of Washington, Oregon, and Alaska.

The Des Moines (Iowa) Steel Tank Co., has been purchased by C. E. Chapman, Kansas City, Mo., for a reported consideration of $50,000. John H. Albrecht, who organized the tank company 12 years ago is now launching the Des Moines Steel Building Co. Mr. Chapman, new owner has been division sales manager for the Columbian Steel Tank Co., Kansas City, and recently was elected president of the Steel Tank Manufacturers Association.

The 60 x 100-ft. addition to the Chamberlain Machine Works, Waterloo, Iowa, will be completed this week, Floyd L. Chamberlain, president, announced and production of the newly added line of clothes ironing machines will be started. The plant is now producing 1,000 clothes wringers daily.

The Gisholt Machine Co., of Madison, Wis., has recently appointed several district representatives: A. R. Engler, 6851 Epland Way, Philadelphia; Arnold S. Beckman, 850 Potomac Ave., Buffalo, N. Y., and T. G. LaManna, 6818 Washington Ave., St. Louis.

The Norton Co., Worcester, Mass., has started work on the construction of an abrasive crushing mill and an addition to the grain storage building in order to enlarge its capacity for crushing, preparing and storing abrasive grain to meet the increased demand for grinding wheels.

The Wesley Steel Treating Co., Milwaukee, Wis., has increased its capital stock from $100,000 to $150,000. The funds will be used to purchase two car-type furnaces, one gas-fired and the other electrically heated. This additional equipment will double the present capacity.

W. L. Brubaker & Bros. Co., of Millersburg, Pa., has recently built a one-story addition to its plant, 100x76 ft. New equipment is being installed, and it is expected that production will be increased 25 per cent.

The Spicer Manufacturing Corporation, Toledo, Ohio, has purchased the plant of the Royal Varnish Co., which adjoins its new plant now being doubled in size to provide space for 2,000 workers.

The Foote Co., Inc., Nunda, N. Y., manufacturer of road-building machinery, and formerly owned by Charles E. Foote as president, is now under the control of Fred L. Dake, president. Ray Brooks is vice-president in charge of sales, and Clifford Messenger is also associated with the company.

The Paragon Die Casting Co., Chicago, has been incorporated with a capitalization of $50,000, to manufacture and deal in tools and machinery.

Personals

JOSEPH G. WORKER has been elected vice-president of the Electrical Hoist Manufacturers' Association. He is also a director and was former president of the Stoker Manufacturers' Association. Mr. Worker is a director of the American Engineering Co., and is in charge of its sales activities. He was recently elected director of the American Fluid Motors Co., of Philadelphia, also of the Affiliated Engineering Companies, Ltd., of Montreal, and of Juruick Refrigeration, Inc., of New York.

E. P. BOYER has been elected vice-president of the Alexander Milburn Co., Baltimore, Md. Mr. Boyer became associated with the company in 1919 as the Philadelphia district manager. Later, he established the Milburn Sales Corporation, and late in 1928 was made vice-president of it, as well as of the Milburn Paint Spray Corporation, both being distributors of the products of the Alexander Milburn Company.

H. L. PARR, general manager of the Burgess-Parr Co., Moline, Ill., manufacturers of special alloys and calorimeters, last week announced his resignation from the company. No immediate successor will be named but it is announced that manufacturing activities of the company and its policies will continue as at present. Prof. S. W. Parr is president of the concern.

EVARTS C. STEVENS was elected vice-president of the International Silver Co., Meriden, Conn., and with Craig D. Munson was elected a member of the executive committee. Mr. Stevens will also be in charge of the manufacturing operations in all plants of the company. Other officers of the company were re-elected.

LAWRENCE W. WALLACE, executive secretary of the American Engineering Council and past-president of the Society of Industrial Engineers, has been re-elected president of the Eye Sight Conservation Council of America, which is conducting a nationwide movement for better vision in industry and education.

JAMES H. WHITTAKER, who for many years was with the Brown & Sharpe Manufacturing Co., the Pratt & Whitney Co., and the Davenport Machine Tool Co., is now connected with the Cincinnati Planer Co. in the capacity of general superintendent.

E. C. ANDERSON, formerly connected with the Stocker-Rumely-Wachs Co., of Chicago, has joined the sales force of the Modern Tool Division of the Consolidated Machine Tool Corporation at its Chicago office.

E. F. WHITNEY, manager of the Portland office of the General Electric Co. since 1923, has been appointed assistant manager of the East Central District, with headquarters at Cleveland.

Obituaries

C. E. CARPENTER, for many years president and general manager of E. F. Houghton & Co., of Philadelphia, died of heart disease on April 7 at Miami Beach. He was 67 year old. For the company's house organ, "The Houghton Line," he wrote editorials on social, economic and religious subjects that led to his receiving invitations to address various bodies outside the manufacturing field. In all he made over 1,200 addresses.

HENRY WRAY WELLER, aged 71, vice-president of Babcock, Wilcox and Goldie, McCulloch, Limited, and connected with the original Canadian branch of Babcock and Wilcox, Limited, for the past 30 years, died on April 1, at his home in Montreal. Forty-one years ago he moved to Montreal, when he first took charge of the Canadian branch of his concern. He acted as manager until 1920 when he was appointed vice-president in charge of eastern sales.

H. W. THOMPSON, assistant president and in charge of sales of the Lovell Manufacturing Co., Erie, Pa., died on March 21 at the age of 52, after a short illness. From 1907 to 1925, Mr. Thompson was with Bardons & Oliver, and for twelve years was in charge of the Detroit office of this company. From 1925 to 1927, he was with the Trundle Engineering Co. of Cleveland. Since that time he has been with the Lovell concern.

CARL BENZ, noted German engineer, died at Ladenburg, Germany, on April 3. He was one of the pioneers in the automotive field, having invented the first two-stroke motor more than fifty years ago, and in 1886 he drove the first Benz motorcar through the streets of Munich.

WILLIAM HENRY BROWN, 88 years old, one of the founders and for years president of the old Brown-Ketcham Iron Works in Indianapolis, died recently at his home after an illness of two weeks. In early life Mr. Brown was an architect.

C. S. WICKES, former general superintendent of the Victor Talking Machine Co. of Camden, died on March 31 at the age of 62. He retired from the Victor company in October, 1927, after a service of 25 years.

WILLIAM G. HARRIS, JR., vice-president and general manager of the Canada Metal Co., died at his home in Toronto, Ont., on April 1. From early manhood, Mr. Harris was associated in business with his father, William G. Harris, Sr., president and founder of the company. The Oil-Right Burner Co., the Graham Nail Works, the Aytociatie Manufacturing Co., the Canada Follis Co., and other companies were formed by William G. Harris and his son.

ROBERT GRAY, general manager of the William Gray and Sons-Campbell Co. Ltd., and Gray-Dort automobile organization, Chatham, Ont., died on March 31, in his 67th year.

THOMAS COOPER HAWKINS, president of the Western Drop Forge Co., Marion, Ind., died on Marcch 19, after an extended illness. He was 69 years old.

Forthcoming Meetings

NATIONAL METAL TRADES ASSOCIATION. Convention, Hotel Drake, Chicago, April 24-25. J. E. Nyhan, national secretary, Peoples Gas Building, Chicago, Ill.

AMERICAN WELDING SOCIETY. Annual meeting, April 24-26, at the Engineering Societies Bldg., New York. M. M. Kelly, secretary, 29 West 39th St., New York.

AMERICAN MANAGEMENT ASSOCIATION. Annual meeting, Hotel Pennsylvania, New York, May 7. W. J. Donald, managing director, 20 Vesey St., New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Eastern Spring meeting, Rochester, N. Y., week of May 13. Third national meeting of the aeronautic division, St. Louis, Mo., May 27-30. Semi-annual meeting, Salt Lake City, Utah, July 1-4. Third national meeting of the Iron and Steel Division, during the Steel Treaters' Exposition, Cleveland, September 11-13. Calvin W. Rice, secretary, 29 West 39th St., New York City.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION. Thirteenth annual meeting to be held in the Hotel Statler, Cleveland, Ohio, May 16-18. T. W. Owen, secretary, 3608 Euclid Ave., Cleveland.

AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting, June 24-28, at the Chalfonte-Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

SOCIETY OF AUTOMOTIVE ENGINEERS. Summer meeting, Saranac Inn, Upper Saranac Lake, N. Y., June 25-28. Coker F. Clarkson, manager, 29 E. 39th St., New York.

NATIONAL METAL CONGRESS. To be held in Cleveland September 9 to 13. Simultaneous meetings of the American Welding Society; the Institute of Metals Division, American Institute of Mining & Metallurgical Engineers; the Iron & Steel Division, American Society of Mechanical Engineers; the Iron & Steel Division, A.I.M.E.; and the American Society for Steel Treating.

The Weekly Price Guide

Rise and Fall of the Market

FIRMNESS with upward tendency prevails in prices of iron ore, pig iron, scrap, semi-finished steel and finished material. The market for non-ferrous metals is quiet, in direct contrast with the present activity in iron and steel. The principal price advance of the week was a rise of 10c. per 100 lb. in black and galvanized steel sheets at Cleveland, while the most important decline was a general reduction of scrap non-ferrous metal quotations in all grades except zinc. Linseed oil is off 0.1c. per lb., to 11.3c. at Chicago.

(All prices as of Apr. 5, 1929)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$18.94
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 1.75@2.25)	24.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	15.50@16.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	20.76
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	21.26
PITTSBURGH, including freight charge ($1.75) from Valley:	
No. 2 Foundry	19.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	4.50
Cleveland	5.00
Cincinnati	4.50
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.35	3.25	3.90*
No. 12	2.15@2.25	3.40	3.30	3.95*
No. 14	2.25@2.35	3.45	3.35	4.00*
No. 16	2.35@2.45	3.55	3.45	4.10*
Black				
Nos. 18 to 20	2.65@2.75	3.60	3.50	3.80
No. 22	2.80@2.90	3.75	3.65	3.95
No. 24	2.85@2.95	3.80	3.70	4.00
No. 26	2.95@3.05	3.90	3.80	4.10
No. 28	3.10@3.20	4.50	3.95	4.25
Galvanized				
No. 10	2.80@2.90	3.95	3.85	4.05
Nos. 12 to 14	2.90@3.00	4.05	3.95	4.15
No. 16	3.00@3.10	4.15	4.05	4.25
No. 18	3.15@3.25	4.30	4.20	4.40
No. 20	3.30@3.40	4.45	4.40	4.55
No. 22	3.35@3.45	4.50	4.45	4.60
No. 24	3.60@3.70	4.65	4.55	4.75
No. 26	3.75@3.85	4.90	4.80	5.00
No. 28	4.00@4.10	5.15	5.05	5.25

*Up to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Glav.
1 to 3 in., butt welded	50%	36%	55½%	43½%	54%	41%
2½ to 6 in., lap welded	45%	32%	53½%	40½%	51%	38%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb:

Thickness—Decimal Fractions	B.w.g. and	Outside Diameter in Inches						
		¼	⅜	½	⅝	¾	1	1¼
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.25†	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10†	5.30	5.00
Cold drawn, round or hexagon‡	3.50	3.65	3.60
Cold drawn, flat or square‡	4.00	4.15	4.10
Structural shapes	3.30†	3.00	3.10
Soft steel bars	3.25†	3.00	3.00
Soft steel bar shapes	3.25†	3.00	3.00
Soft steel bands	3.75†	3.65	3.65
Tank plates	3.30†	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick. †Up to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire, New York, $\frac{3}{32}$, 8.35c.; $\frac{1}{8}$, 7.85c.; $\frac{5}{32}$ to $\frac{1}{4}$, 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:			
Copper, electrolytic, New York			24.75
Tin, Straits, pigs, New York			52.25
Lead, pigs, E. St. Louis	7.65	New York	9.25
Zinc, slabs, E. St. Louis	6.80	New York	8.25

	New York	Cleveland	Chicago
Antimony, slabs	12.50	13.00	14.25
Copper sheets, base	33.75	33.75	32.75
Copper wire, base	29.37½	24.50	24.87½*
Copper bars, base	32.25	32.25	31.25
Copper tubing, base	35.12½	35.12½	34.12½
Brass sheets, high, base	27.12½	27.62½	26.37½
Brass tubing, high, base	32.00	32.50	31.25
Brass rods, high, base	24.87½	25.37½	24.12½
Brass wire, high, base	27.62½	28.12½	26.37½

*At mill.

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25.00*	24.30	24.30
Zinc sheets (casks).....	10.00@10.50	11.70	10.11
Solder (½ and ½).....	35.25	34.00	31@34
Babbitt metal, delivered in case lots, New York, cents per lb:			
Genuine, highest grade.....			70.00
Commercial genuine, intermediate grade.....			54.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt (f.o.b.).....			12.75

*Delivered.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va:

	Nickel	Monel Metal
Sheets, full finished.....	52.00	42.00
Sheets, cold rolled.....	60.00	50.00
Strip, cold rolled.....	55.00	45.00
Rods, hot rolled.....	45.00	35.00
Rods, cold rolled.....	53.00	40.00†
Tubing.....	75.00*	90.00
Angles, hot rolled.....	50.00	40.00
Plates.....	52.00	42.00

*Seamless. †Cold drawn.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars, depending on quantity offered for sale:

	New York	Cleveland	Chicago
Crucible copper.....	20.25 @20.50	19.00	18.00 @18.50
Copper, heavy, and wire..	18.50 @20.00	18.75	17.00 @17.50
Copper, light, and bottoms	16.50 @17.00	16.50	16.00 @16.50
Heavy lead.....	6.25 @ 6.75	6.25	6.00 @ 6.50
Tea lead.....	4.75 @ 5.25	4.25	5.00 @ 5.50
Brass, heavy, yellow.....	11.00 @11.50	12.00	11.00 @11.50
Brass, heavy, red.....	.....	16.00	15.50 @16.00
Brass, light.....	9.00 @ 9.50	11.00	10.00 @10.50
No. 1 yellow rod turnings.	12.00 @12.50	12.50	12.00 @12.50
Zinc.....	3.50 @ 4.00	3.25	3.25 @ 3.75

TIN PLATES—Charcoal—Bright—Per box:

	New York	Cleveland	Chicago
"AAA" Grade:			
IC, 14x20.....	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20.....	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20.....	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.*	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.*	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.†.....	.16	38.00 per M	.16
Sal soda, per lb.....	.02	.02	.02
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.....	.109	.11	.113
Cutting oil, about 25% lard, in 5 gal. cans, per gal.....	.55	.60	.65
Machine oil, medium-bodied (55 gal. steel bbl.) per gal..	.33	.36	.35
Belting — Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin. ft., per inch of width, for single ply:			
Medium grade.....	30–10%	30–10%	35%
Med. grade, heavy wgt...	30– 5%	30– 5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft:			
First grade.....	50%	50–10%	50%
Second grade.....	60%	60– 5%	50–10%

*All waste in bale lots. †100-lb. bales.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb..	$0.0325	$0.0325	$0.0324
Cold drawn shafting...	per lb..	.035	.035	.034
Brass rods.....	per lb..	.2487½	.205	.165
Solder (½ and ½).....	per lb..	.3525	.3475	.34
Cotton waste, white...	per lb..	.10@.13½	.10@.13½	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1, 6-in. dia.....	per 100.	3.60	3.59	3.10
Lard cutting oil.....	per gal.	.55	.55	.65
Machine oil.....	per gal.	.33	.33	.30
Belting, leather, medium.....	off list..	30–10%	30–10%	35%
Machine bolts, up to 1x30 in., full kegs...	off list..	50-10%*	50–10%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper.....	$4.50	$4.29	$4.29
Emery cloth.....	22.93	20.97	20.97
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper.....	2.64	2.04	2.04
Cloth.....	3.60	3.59	3.59
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.75@2.85
Coke, prompt foundry, per net ton...	Connellsville,		3.75@4.50
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less.....	60%
Larger, up to 1 x 30-in., full kegs, list less.....	50–10%
Less than full kegs or case lots, add to list.....	10%
Fitting-up bolts: list less.....	45%
Lag screws:	
Up to ½-in. x 6-in., list less.....	60%
Larger, list less.....	50–10%
Less than full keg or case lots, add to list.....	10%
Rivets:	
Structural, round head, full kegs, net.....	$4.50
Structural, round head, broken kegs, net.....	6.00
Tank, 7–16-in. dia. and smaller, list less.....	60%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less.....	60%
Larger, up to 3-in., list less.....	40–10%
Less than keg or case lots, add to list.....	10%
Washers:	
Wrought, full kegs, per 100 lb., list less.....	$4.00
Wrought, broken kegs, per 100 lb., list less.....	2.00
Turnbuckles:	
With stub ends, list less.....	20%
Without stub ends, list less.....	50%
Chain:	
Proof coil, base, per 100 lb., net.....	$7.10
Cast iron welding flux, per lb., net.....	.40
Brazing flux, per lb., net.....	.80

Machine Requirements and Industrial Construction

Equipment Wanted

Ill., Divine—Dept. of Purchases & Construction, Div. of Purchases & Supplies, Capitol, Springfield—will receive bids until Apr. 19 for new or used equipment including lathe, drill press, steam locomotive crane, jack hammer drill, drift sharpener, pipe cutting and threading machines, combination cut-off and rip saws, band saw, etc. for Dresden Island lock and dam site here.

Mass., North Reading—J. E. Turner—18 or 20 in. round head Buzz plane, motor driven.

Mich., Detroit—Cadillac Motor Car Co., Clark Ave.—assembly line of equipment for proposed 1 story plant. Estimated cost $250,000.

Mich., Detroit — Frederick Colman & Sons, 7250 Central Ave.—milling and boring machines.

Mich., Detroit — Commonwealth Brass Corp., 5781 Commonwealth Ave.—automatic screw machine.

Mich., Detroit—Dept. of Purchases & Supplies, 735 Randolph St., J. E. Mills, Comr. —three electrically driven rotary grinders and seven dynamoter electric welding machines.

Mich., Detroit—Detroit Precision Tool Co., Jefferson and Bellevue Aves.—machine shop equipment.

Mich., Detroit—Murdock Tool Co., 1745 Abbott St.—milling machine.

Mich., Detroit—Richard Bros Die Works, 4646 Lawton Ave.—10 and 15 ton traveling bridge cranes for proposed 1 story, 95 x 205 ft. die shop. Estimated cost $90,000.

O., Cleveland—Carter Products Co., 983 Front Ave., F. Carter (window cleaners)—punch press, No. 20 Bliss.

O., Cleveland—Gear and Forgings Inc., 3010 Woodhill Rd.—cylinder grinders.

O., Portsmouth—R. Bayerl, S. E. Frowine and E. Wece—machinery and equipment including grinders for recently acquired plant.

Ont., Listowel — Andrew Malcolm Furniture Co.—complete machinery and equipment for proposed 3 story, 110 x 165 ft. addition to machine, assembly and finishing shops on Main St. Estimated cost $100,000.

Ont., Walkerville — Eclipse Mfg. Co., R. W. Keeley, Mgr.—machinery and equipment for the manufacture of automobile drives and brakes for proposed 1 story, 100 x 300 ft. addition to factory on Argyle Rd. Estimated cost $150,000.

Opportunities for Future Business

Calif., Downey—Emsco Aircraft Corp. let contract for a 1 story, 100 x 300 ft. factory.

Calif., Huntington Park — Ensign Carburetor Co., 217 East 17th St., Los Angeles, awarded contract for the construction of a factory here. Estimated cost $40,000.

Calif., Emeryville—Westinghouse Electric & Mfg. Co., 1 Montgomery St., San Francisco, plans addition to factory. Estimated cost to exceed $100,000.

Calif., Torrance — Hercules Portland Cement Co., Washington and 4th Sts., will soon receive bids for an 8 story plant including machine shop, etc. Estimated cost $2,500,000. Noted Jan. 24.

Conn., Bridgeport—Bridgeport Brass Co., R. Day, Gen. Mgr., awarded contract for a 1 story, 75 x 200 ft. plant. Estimated cost $100,000.

Conn., Bristol—New Departure Mfg. Co., plans a 128 x 404 ft. building for finish race grinding department.

Conn., Hartford—Hartford Electric Light Co., S. Ferguson, Pres., Pearl St., will soon award contract for a 4 story, 160 x 180' ft. service building on Sheldon St. Estimated cost $400,000. Smith & Bassette, 36 Pearl St., Archts. E. W. Wiggin, 113 Church St., New Haven, Engr. Noted Mar. 14.

Conn., Waterbury — Bristol Co., Platts Mills, is having plans prepared for a factory for the manufacture of recording instruments. Estimated $40,000. F. A. Webster, 51 West Main St., Archt.

Ill., North Chicago (Chicago P.C.)—American Can Co., 104 South Michigan Ave., Chicago, had plans prepared for the construction of a 1 story factory for the manufacture and repair of can closing machines at Sheridan Rd. and 14th St. here. Estimated cost $500,000.

Ind., Alexandria—Aladdin Industries Inc., awarded contract for the construction of a machine shop. Noted Mar. 21.

Ind., Gary — Pacific Electric Mfg. Co., 5815 3rd St., San Francisco, awarded contract for addition to plant at Dunes Highway here. Estimated cost $50,000.

Ia., DeWitt—Vasen Mfg. Co., G. Vasen, awarded contract for a 2 story, 40 x 192 ft. addition to light manufacturing plant. Estimated cost $75,000.

Mass., Attleboro—Mossberg Pressed Steel Co., F. Mossberg, 81 West St., plans a 1 story, 100 x 300 ft. plant. Estimated cost $200,000. Architect not selected.

Mass., Back Bay—W. M. Corbett, c/o Eisenberg & Feer, 11 Beacon St., Archts., awarded contract for a 1 story, 100 x 120 ft. repair and service garage at Fenway and Kilmarnock Sts., here. Estimated cost $60,000.

Mass., East Boston (Boston P. O.) — Park Dept., 33 Beacon St., is having plans prepared for a 1 and 2 story, 75 x 115 and 30 x 45 ft. repair and service garage at Jeffries Point airport. Estimated cost $125,000. W. D. Austin, 120 Boylston St., Boston, Archt.

Mass., Lynn—North Shore Cutting & Die Co., 266 Broad St., awarded contract for a 1 story factory on Broad St. Noted Mar. 21.

Mass., Waltham—J. L. Thompson Mfg. Co., South St., awarded contract for a 1 story, 100 x 200 ft. header shop. Noted Apr. 4.

Mass., Wrentham — Winter Bros., Co., Kendrick St., awarded contract for a 1 story, 40 x 100 ft. addition to machine shop.

Mich., Jackson—Sparks-Withington Co., North Main St., awarded contract for a 3 story, 60 x 250 ft. radio plant. Estimated cost $150,000.

Mo., St. Louis—South Side Machine Co., 3600 Nebraska Ave., awarded contract for a 1 story, 100 x 100 ft. machine shop at 3762 Eichelberger St. Estimated cost $0,000.

N. J., Englewood—J. and A. Pasternack, 255 Harrison Ave., Passaic, will build a 1 story, 180 x 180 ft. garage, etc., at Palisade and Grand Aves. Estimated cost $175,000. F. Pirrone, 104 Midland Ave., Garfield, Archt.

N. J., Jersey City — Milrog Construction Co., c/o S. Shilowitz, 26 Journal Sq., Archt., is having sketches made for a 2 story, 100 x 200 ft. garage, etc., at Montgomery St. Estimated cost $150,000.

N. J., Ridgewood—A. Bonaparte, c/o D. J. Scrocco, 60 Park Pl., Newark, will build a 1 story, 100 x 145 ft. garage on Maple Ave. Estimated cost $150,000.

N. J., Secaucus — New York Air Terminals Inc., R. F. Hoyt, 25 Broad St., New York, N. Y., awarded contract for an airport including hangars, machine shops, garages, etc. here. Estimated cost $8,000,000. Noted Mar. 21.

N. Y., Brooklyn — Segal Lock & Hardware Co., Walcott and Ferris Sts., awarded contract for the construction of an iron foundry.

N. Y., Brooklyn — Pioneers Instrument Co., C. H. Colvin, Pres., 745 Lexington Ave., New York, awarded contract for addition to factory here. Estimated cost $50,000.

O., Canton—Timken Roller Bearing Co., Dueber Ave. S. W., plans the construction of a 380 x 520 ft. factory. Estimated cost $500,000. Private plans.

O., Cleveland—Cleveland Cap Screw Co., J. Fribley, Pres. and Mgr., 2921 East 79th St., awarded contract for a 1 story addition to factory. Estimated cost $65,000.

O., Cleveland — J. A. Cline, Williamson Bldg., awarded contract for a 1 story, 80 x 180 ft. sales and service building at Doan and Euclid Aves. Estimated cost $150,000.

O., Cleveland—Cream Cone Machine Co., J. W. Taylor, Pres., 1874 East 59th St., plans a 3 or 4 story, 57 x 65 ft. addition to factory at 5800 Hough Ave. Estimated cost $50,000. Architect not selected.

O., Cleveland—Metal Equipment Co., c/o G. F. Walzer, Pres., 2035 West 106th St., awarded contract for a 2 story, 60 x 123 ft. factory. Estimated cost $50,000.

O., Cleveland — Union Cap Screw Co., 13603 Union Ave., had plans prepared for a 1 story, 61 x 73 ft. machine shop. Estimated cost $40,000. F. J. Hronek, 3529 East 113th St., Archt.

O., Columbus—White Motor Co., G. H. Kelly, Treas., 842 East 79th St., Cleveland, awarded contract for a 1 story, 100 x 120 ft. automobile sales and service station on West Town and Skidmore Sts., here. Estimated cost $150,000.

O., Geneva—American Fork & Hoe Co., G. B. Durell, Pres., B. F. Keith Bldg., Cleveland, awarded contract for a 2 story, 40 x 200 ft. factory here. Estimated cost $40,000. Noted Mar. 28.

O., North Canton — Hoover Suction Sweeper Co., awarded contract for a 4 story, 80 x 190 and 60 x 160 ft. addition to factory. Estimated cost $250,000.

Pa., Braddock—Wilson Snyder Mfg. Co., is having plans prepared for a 1 story, 60 x 127 ft. addition to machine shop on Talbot Ave. Estimated cost $40,000. Private plans.

Tex., Big Springs—Texas & Pacific Ry. Co., Dallas, plans the construction of a roundhouse, machine shop, etc., here. Estimated cost $600,000. E. F. Mitchell, Dallas, Ch. Engr.

Pa., Philadelphia — Reyburn Mfg. Co., 32nd St. and Allegheny Ave., manufacturers of toys, plans a 5 story, 100 x 245 ft. factory. L. B. Rothchild, 215 South Broad St., Archt.

Pa., Philadelphia—Edgcomb Steel Co., 11th and Cambria Sts., awarded contract for a 2 story, 56 x 240 ft., warehouse at D. and Erie Sts. Estimated cost $160,000.

Pa., Trafford — Westinghouse Electric & Mfg. Co., East Pittsburgh, will build a 1 story, 60 x 182 ft. addition to foundry here. Estimated cost $50,000. B. H. Prack, Martin Bldg., Pittsburgh, Archt.

Alta., Edmonton — Dingwell & Dixon plan the construction of a plant to be known as Standard Iron Works. Estimated cost $100,000.

Ont., Copper Cliff—International Nickel Co., 67 Wall St., New York, N. Y., will build a copper refinery here. Estimated cost $4,000,000.

Ont., Mount Dennis — Ferrante Electric Ltd., 26 Noble St., Toronto, is having plans prepared for the construction of factory here. Estimated cost $100,000. Dwart, Armer & Byam, Ltd., 36 Toronto St., Toronto, Archts.

Ont., Toronto—Prest-O-Lite Storage Battery Co., 805 Davenport St., awarded contract for the construction of a factory. Estimated cost $125,000.

Que., St. Johns—Columbia Match Co., plans the construction of a factory. Estimated cost $250,000. Architect not selected.